SCIENTIFIC AMERICAN

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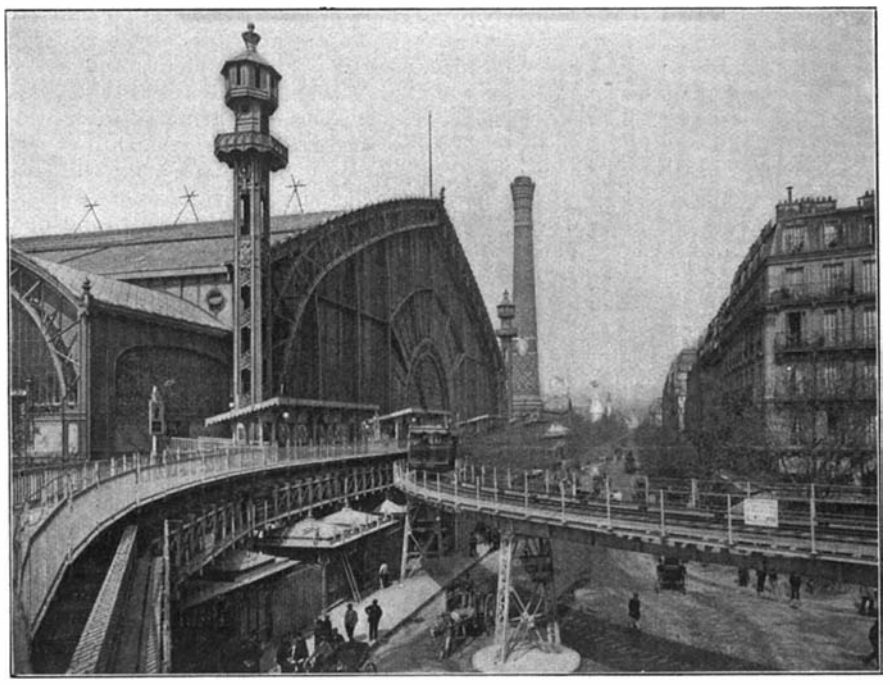
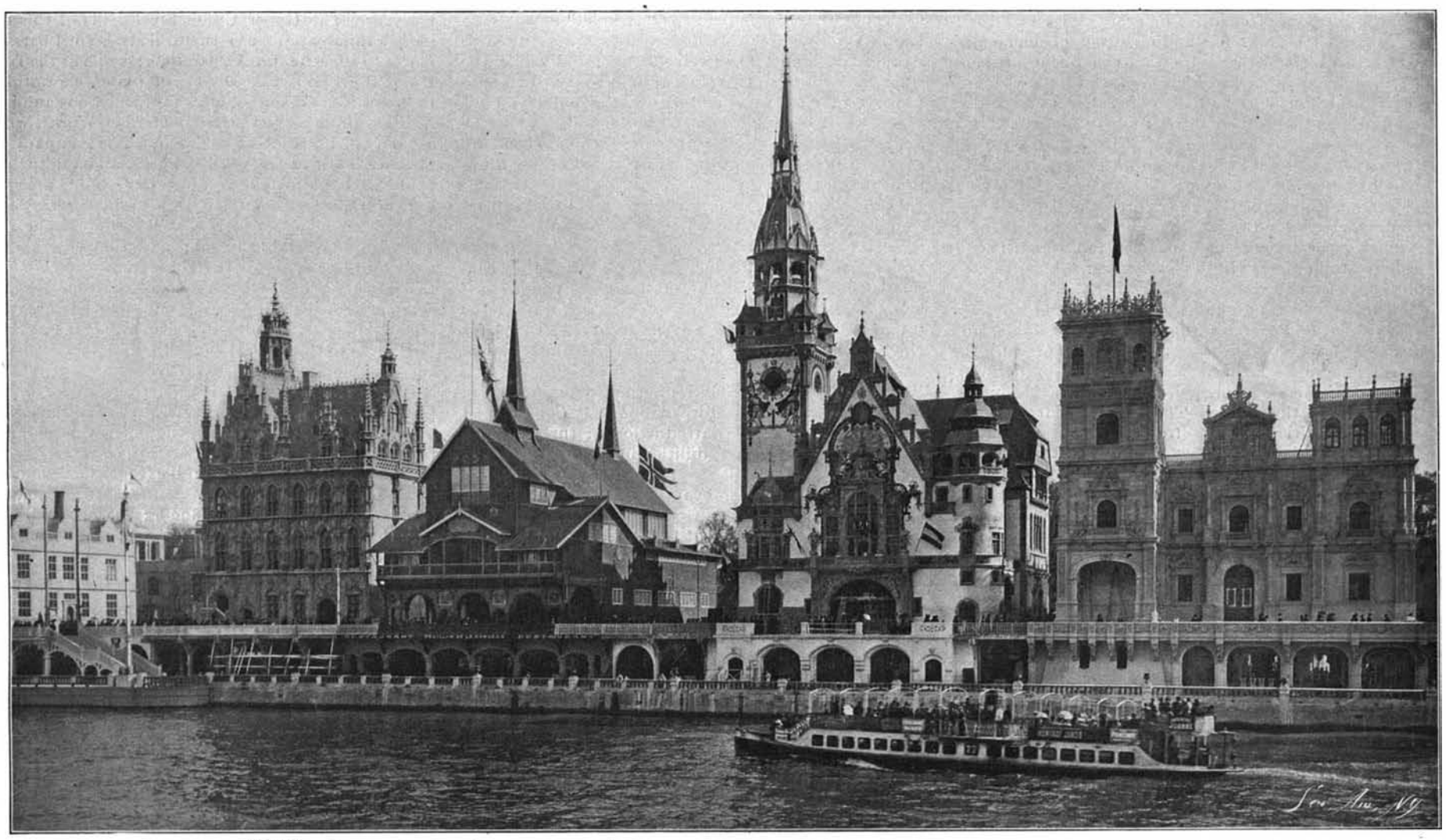
The Large Palace of Fine Arts.

The Small Palace of Fine Arts.

The Moving Platform.



The Electric Railway and End of Electricity Building.



Great Britain. Belgium. Norway. Germany. Spain.

The "Street of Nations," on the Bank of the Seine.

THE PARIS EXPOSITION.—[See page 86.]

Scientific American.

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NEW YORK, SATURDAY, AUGUST 11, 1900.

THE PROTECTION OF AMERICAN GAME.

In our last issue we mentioned the convention which was recently signed in London for the preservation of wild animals, birds, and fish in Africa. It is gratifying to note that America has not been backward in the movement, which may be called international, to protect animals of certain species from wanton destruction.

A careful inquiry recently made by the New York Zoological Society reveals the startling fact that throughout thirty States and Territories the decrease in the volume of bird life during the last fifteen years has reached an average of forty-six per cent. The decrease in the number of edible birds has even been greater than that, and a number of our finest species are now approaching practical extinction and many of our song birds are being killed for food.

The sportsman has long realized the need of protective measures, but the farmer has only recently learned to appreciate the full value of birds as insect destroyers. Cheap guns, lax laws, the mania for collecting and shooting, and more especially the enormous demands for the market and millinery trade, are responsible for this reduction in bird life. The protection of birds is a national not a local question; it deals largely with migratory species which breed in one section, winter in another, and traverse several States in passing to and from the breeding grounds. In the SUPPLEMENT of the current week will be found an abstract of a bulletin issued by the Biological Survey of the Department of Agriculture in which many significant facts are mentioned. There are 1,125 species and sub-species of birds inhabitating North America north of Mexico, and of these only about 200 or 18 per cent can be considered game birds. From this will be seen the importance of protecting birds other than game birds. As an instance of the lack of uniformity in the State laws take the common dove, for example; in twelve States it is protected at all times, in nineteen at certain times, while in the others it has no protection at all. Several protective associations have done excellent work.

The League of American Sportsmen was organized for the purpose of creating in every State and Territory a well organized standing army of game protectors, which shall secure the enactment of more stringent general laws, which shall see that lawlessness is punished, which shall discourage game slaughter, and protect the wild creatures that still remain.

At present the League has working divisions in twenty-four States, and in two provinces in Canada, the membership including the governors of several States, members of Congress, presidents of colleges, judges, etc. The League has been very prominent in securing the passage of the Lacey bill, which is considered to be the greatest victory ever achieved in the interest of game and song bird protection.

The States can now enforce their laws, and wherever they fail the Federal authorities will interpose, and where States do not take measures to prevent the smuggling of game out of their boundaries, the Interstate Commerce Commission, backed by the Lacey law, will come to the rescue. This will prevent the shipping of prairie chickens from Minnesota or other States to Chicago or New York labeled "poultry." There will be no more shipping of venison from Wisconsin or Minnesota to Chicago or New York labeled "veal" and "mutton"; there will be no more slaughter of seagulls on the New England coast or elsewhere in violation of the laws of the State, and shipping them to millinery dealers in New York, no matter how labeled. The League will have a force of detectives at work in all of the large cities watching for any violation of the Lacey law, which imposes a penalty of $200 for every infraction of said law.

The League of American Sportsmen does not wish to curb sport in any way. It believes in a reasonably filled gamebag, but considers that the killing of game and the taking of fish should be limited by law, not only as to seasons, but that the bag for one man for a day and for a season should be defined by law. The league has rendered efficient service in ascertaining the fact that seven of the hotels in New York, and several game dealers, had been selling game in closed season, and has secured from them written pledges to stop violating the game laws. It has also absolutely stopped the selling of game in New York at all times except in open season.

The people of the country are becoming satisfied that some organized measures must be taken to preserve the feathered tribes which inhabit our woods from the wicked and ignorant slaughter which bids fair to render some varieties of our birds extinct species.

HIGH SPEED IN WAR VESSELS—THE "VARIAG" AND THE "VIPER."

The details of the successful trial of the protected cruiser "Variag," which has been built at the Cramps' Yard, Philadelphia, Pa., for the Russian navy, show that this vessel is well able to live up to her contract requirements of 23 knots an hour. The contract specified that the speed trial should be an extraordinarily severe one. The vessel was to maintain a sea speed of 23 knots an hour for a run of twelve consecutive hours. During a preliminary builders' trial she is said to have logged for a time the remarkable speed of 24·6 knots an hour, covering ten miles at 24·2 knots. This, of course, will not be quoted as the official speed of the vessel, as trials by log are not regarded as fully reliable; but on the official trial, where the times are taken over a measured course, there is no possibility of error, and the fact that this vessel maintained for over seven hours a continuous speed of from 23·6 to 23·7 knots an hour, was considered by the Russian officials to be sufficient evidence that she could have maintained the same speed for the whole twelve hours, had it not been for an accident to one of the high pressure cylinders.

This splendid result is extremely gratifying both to the representatives of the Russian Navy and to the American builders of the ship. The William Cramp & Sons Ship and Engine Building Company had already achieved world-wide distinction in the construction of fast warships by the remarkably high speeds which were attained by the "Minneapolis" and "Columbia," vessels of somewhat the same character as the "Variag," and about 1,000 tons more displacement. The "Columbia" is credited with a speed of 22·8 knots an hour, and the "Minneapolis" with slightly over 23 knots. The "Variag," with her record of 23·7 knots, now takes the place of the "Minneapolis" as the fastest first-class cruiser in the world, although she is exceeded in speed by two second-class cruisers, which, strangely enough, are to be found in the Chinese Navy. The "Hai-Tien," a second-class cruiser of 4,300 tons displacement and 17,000 horse power, achieved a speed on her official trial of 24·1 knots an hour. A sister ship of the "Hai-Tien," the "Hai-Chi," made 24 knots on her official trial. These two vessels, however, are smaller than the "Variag" by 2,200 tons, and it is doubtful if in any but the finest weather they could hold their own with the American-built ship.

The "Variag" is one of the four protected cruisers which are being built for Russia in various foreign shipyards. Two of these, the "Bogatyr" and the "Boyarin," must be about completed at Stettin and Copenhagen, and a fourth, the "Askold," at the Germania Yards at Kiel. All four vessels are required to steam at 23 knots for twelve hours; and while the ships conform to a general pattern in respect of armament, coal endurance and speed, the builders have been given a free hand in matters of detail. When the quartette is completed, it will be interesting to compare the work of American builders with that of the European yards mentioned.

At the close of the trial the officers and naval experts commissioned by the Russian Government to superintend the trial of the "Variag" congratulated the builders on her performance and stated that they considered the cruiser to be one of the great triumphs of naval construction. An illustrated description of the "Variag" was given in the SCIENTIFIC AMERICAN for November 5, 1898; and the "Askold" is illustrated in the issue of June 30, 1900.

Further details at hand of the wonderful speed recently made by the torpedo boats "Cobra" and "Viper" show that the introduction of turbo-propulsion has opened up possibilities in speed, the limits of which it is difficult to predict. It is only five years since the torpedo boat destroyer "Sokol," built at Poplar, for the Russian Government, astonished the world by making a speed of 30 knots an hour; yet today 30-knot destroyers have ceased to excite interest; and the success of the "Viper" in covering a measured mile at the rate of 37·1 knots an hour is already leading us to regard 40 knots an hour as the next goal at which to aim.

The "Viper" is 210 feet long, 21 feet wide, and has a draught of 7 feet. On the recent trial she displaced 380 tons, or 10 tons more than the contract requirement. Six runs were made over the measured mile at the following speeds in knots: 36·5; 35·5; 37·1; 36 6; 37·1, 36·1, the mean speed being 36 58 knots per hour. The highest speed attained is equal to about 43 land miles per hour. The turbines indicated 13,000 horse power at 1,180 revolutions per minute, under a steam pressure of 200 pounds to the square inch.

The remarkable success of turbo-propulsion naturally invites speculation as to the possibilities of the future, not merely in torpedo boats but in the larger field of the cruiser and battleship. Then, again, there is the question of its application to the merchant marine, where the record for speed now stands at 23 knots an hour. There is no doubt that the turbine could be applied successfully to a 25,000-ton liner, and that speeds of 30 knots and over could be realized; but it would be at a cost for fuel that would be absolutely prohibitive. Indeed, Mr. Parsons, the inventor of the turbine, has stated that he could put turbines and boilers in a Transatlantic liner that would drive her across the ocean in three days, if the owners of the vessel would be willing to burn the 10,000 to 12,000 tons of coal that would be consumed in the furnaces.

Although the Parsons turbine, in proportion to its indicated horse power, is remarkably light and compact, it has a voracious appetite for steam; so much so, that Admiral Melville once said that what surprised him in the "Turbinia" was not so much the indicated horse power of the turbines as the enormous quantities of steam supplied by the boilers. So that, if we are anxious for a three-day crossing of the Atlantic, we must make up our minds to pay for an enormously expensive luxury; so costly, indeed, that the three-day boat, using coal as its fuel and steam in its motors, will probably never pass from the theoretical to the practical stage.

AMERICAN ENGINEERING COMPETITION.

In the current issue of the SUPPLEMENT will be found the fourth article of a series on the subject of American engineering competition, recently contributed to The London Times by a special correspondent of that journal, who made an extensive trip through the manufacturing States of this country with a view to furnishing himself, by personal observation, with the necessary data. The present article deals with the steel works of this country and the methods employed by our iron masters as contrasted with those which prevail in Great Britain. The article brings out some facts of special interest tending to show why it is that steel manufacturers in this country have been able to compete with such remarkable success against the older established industries of Europe. The enormous works of the Carnegie Steel Company are selected as typical of the best American practice, and from the figures given in the article to show the vast extent of the plant, we select the following:

There are three principal works, the Edgar Thomson, the Duquesne, and the Homestead Steel Works, which included, when they were visited by The Times correspondent, seventeen blast furnaces, whose aggregate annual capacity was 2,200,000 tons. The Edgar Thomson Works produced 650,000 tons of rails a year. The Duquesne Steel Works have an annual capacity of 650,000 tons of steel ingots, while that of the Homestead Works is 400,000 tons of Bessemer steel ingots and 1,400,000 tons of open-hearth steel ingots. There is also at the Edgar Thomson Works a foundry which turns out 50,000 tons of iron, steel, and brass castings per year. The Upper Union Steel Mills of this company annually produce structural steel, steel bars, and plates to the extent of 250,000 tons; while at the Lower Union Steel Mills 150,000 tons of plates, car forgings, bridge work, angle iron, etc., are turned out annually. Another property is the Howard Axle Works, with a capacity of 100,000 tons per year. The company also possesses most extensive coke works, and a natural gas field of 206 square miles. They have built their own line of railway from Lake Erie to Pittsburg, at the Lake Erie end of which is a well-equipped dock and ore handling establishment; and they operate also their own line of steamers. These transportation facilities serve to bring 5,500 000 tons of ironstone from the company's own Lake Superior mines to the great system of forges and mills above mentioned near Pittsburg. As to the capital invested and turned over in these vast operations it is sufficient to say that, in a recent threatened litigation, it transpired that the profits of the company in 1898 were estimated at $21,000,000, and in 1899 at the enormous figure of $40,000,000.

It seems that the American blast furnace is not, as a rule, any larger than those used in Great Britain, and, of course, the process of reducing the ore is, broadly speaking, the same. But there is one respect in which the practice of the blast furnace managers is radically different; and this is, that in the United States it is customary to force the production much more than it is elsewhere. The larger output per furnace in America is, of course, due, in some measure, to the superior quality of the ore, but the extremely high yield is to be mainly credited to the American practice of driving the furnaces, as they expressively put it, "for all they are worth."

The deciding factor in the economics of blast furnace operation is the wear and tear of the interior lining of the furnace, which, as soon as it has been burnt away to a definite minimum thickness, has to be renewed. The work of lighting one of these huge furnaces is so costly that they are run continuously, night and day,

from the time they are started until the interior lining is worn out, and the furnace has to be "blown down" to receive a new lining. Since the stopping of a furnace and the building up of the inner lining are extremely costly, it becomes a question whether the best economical results are obtained by driving the furnace at a moderate speed, and thereby prolonging its life, or driving at extremely high pressure, with a view to securing a very large annual output, and making repairs at correspondingly frequent intervals. British practice favors the first method, American the second; our ironmasters believing that since "a lining is good for so much pig, the sooner it makes it the better." The difference in practice is shown by the fact that whereas the largest Middlesbrough furnaces, with a capacity of 36,000 cubic feet each, produce only 950 tons of pig iron per week per furnace, the Duquesne furnaces, with a capacity of 25,000 cubic feet, have produced 4,200 tons per week. Of course, the life of the American furnaces, working under this terrific pressure, is very much shortened, lasting on an average only four years, as against one case where the lining of a British furnace lasted eighteen years.

Another broad distinction between British and American furnaces is sententiously expressed by The Times correspondent, when he says "nothing seemed to me more notable at the Duquesne Works than their loneliness." He further says: "Had it not been for the subdued hum, characteristic of a furnace in blast, one might have thought that the works were shut down," —so completely had mechanical appliances taken the place of hand labor. In the production of steel ingots, rails, plates, etc., from the mine to the mill, the American instinct for labor-saving has been followed even to detail. From the iron mine in Minnesota to the shipment of the finished product on the cars at Pittsburg, the American ironmaster does not expect any hand labor to appear in the whole process of manufacture, the single exception being the filling of the buckets which take the ore out of the ship on the lakes, for which spadework is employed.

Of course, as has been suggested above, one great advantage enjoyed by American steel manufacturers is the extraordinary richness and accessibility of the iron ore in the Lake Superior region, immense masses of which lie on the slopes of the hills, covered only by a thin layer of surface soil. A railway track, quickly laid over the surface of the ground, brings into operation a steam shovel which, digging up the ore at the rate of five tons to the shovelful, at five strokes will fill a 25-ton ore car, and will load a train of cars at the rate of 600 tons an hour. The significance of such work as this, in connection with mines so extensive and rich, will be more fully appreciated when we remember that in the Mesaba range alone there are in sight 400,000,000 tons of iron ore.

PETROLEUM FUEL FOR WARSHIPS.

BY ALTON D. ADAMS.

The speed and steaming radius of fighting ships is of the highest importance. Unfortunately, however, the requirements for high speed and for a long steaming radius are conflicting, both as to equipment and operation. The higher the speed to be maintained the greater must be the weight of driving machinery in a given case. The greater the actual rate of speed for a ship, the shorter its steaming radius. Both of these conditions result from the fact that the power required to force any vessel through the water varies approximately as the cube of its speed. A very large part of the tonnage or carrying capacity of a modern warship is taken up by its driving machinery and fuel, so that the constant effort of designers is to lighten the engines and boilers and extend the coal spaces. In so far as the fuel capacity of fighting vessels can be increased, the steaming radius can be lengthened, or the speed over a given distance raised. As far as can now be seen, the capacity for coal in war vessels has been pushed to nearly its utmost limit, unless some important modifications are made in the structure of their hulls or in the weights of the contained machinery. The tendency seems to be toward heavier instead of lighter armor in the most important classes of battleships, and while some gains are being made in the weights of engines and boilers, the net result in this latter direction can hardly be very important. At present the great naval powers of the world are nearly abreast of each other in the adoption of improvements as to the construction and equipment of ships of war. The foregoing makes it quite evident, however, that any great power, applying means to largely increase the fuel capacity of its ships, without impairing their efficiency in other respects, would gain a decided advantage.

Especially would this be true if the means by which the large increase of fuel capacity is attained, is not generally available for the other powers. The ships having longer radii of operation, because of fuel capacities, beyond others of their class, would have still another advantage if the increase extended to the possible speed with given equipment Important as are the advantages just pointed out, they are to-day within the grasp of two of the greatest powers, Russia and the United States. Petroleum is the fuel whose substitution for coal on warships will largely increase their steaming radii and to a smaller extent their speeds. As by far the most important deposits of this substance, thus far developed, are in the United States and Russia, the advantage of these countries in its use is plain. The ability of petroleum to largely increase the fuel capacity of fighting ships, without changing their present dimensions or machinery equipments, lies in its greater heating power over coal per unit of weight and volume. Steam coal of the best grades develops approximately 14,000 heat-units per pound, on perfect combustion. The high grades of petroleum yield 21,000 units of heat per pound, when fully burned. With these two fuels in actual use under steam boilers, the results in the evaporation of water are more favorable to the petroleum than the figures just named indicate, because it is practicable to get more nearly perfect combustion of the oil than of the coal. In present ships, therefore, devoting the same tonnage to petroleum that is now devoted to coal, the fuel capacity with the former is more than 50 per cent greater than with the latter. This increase of fuel capacity gives the ships with oil fuel one and one-half times the steaming radius at any speed, the ability to attain a greater maximum speed and to continue it for a longer period.

Not only is the heating power of petroleum 50 per cent greater than that of coal for the same weight, but the same relation holds good for equal bulk. The weight of petroleum is very nearly 54 pounds per cubic foot, and this figure is also a fair average for a cubic foot of steam coal. Fighting ships may, therefore, increase their fuel capacities by one-half the present values with coal, without adding to either the present tonnage or bulk, by using oil. In the matters of rapid steam raising, long continued operation at maximum capacity, the removal of refuse from the furnace, and the labor of firing, the oil fuel is at a great advantage. Petroleum is fed to the furnace through pipes under pressure, and the heat of the fire is changed at once by regulating the flow of oil and supply of air. Much less than one per cent of the weight of petroleum remains as ash after combustion, while the ratio of ash in coal is 5 to 10 per cent. With oil the labor of firing is to a very large extent avoided, not more than one-fourth of the number of men required for coal are necessary, and their duties are much less exacting. This last point is seen to be of no small importance, when the great strain on the stoking force of war vessels on long and fast runs are considered. Petroleum fuel implies no material change in the steam power equipments now in general use on ships. The oil can be burned under any kind of boiler and its use may even alternate with that of coal. To apply the petroleum it is only necessary to introduce a pipe carrying it, and another pipe with compressed air or steam, into the furnace, and arrange suitable nozzles to insure a mixture of the oil in a finely divided state with the air or steam. Thus far the fuel properties of crude petroleum, as it comes from the earth, have been pointed out, but the heavy oil called refuse, that remains after the more volatile parts are extracted by distillation, has practically the same heating power per unit of bulk. This petroleum refuse constitutes 10 to 15 per cent by weight of the crude oil and is extensively used as fuel by ships on the Black and Caspian Seas and on locomotives in Southern Russia. The great Caspian oil fields and their refineries account for cheap petroleum refuse at the ports of the seas named.

Great as are the advantages to be derived from petroleum fuel on warships with steam power plants, still more favorable results seem possible if internal combustion motors are adopted. Steam boilers and their contained water form a large item in the weight of warship equipments, and the space and tonnage they require would be of the highest value for the storage of fuel. Oil engines require no boilers and consume less fuel than the best steam power equipments per unit of effective work. A fair approximate figure for the weight of ship boiler plants and their contained water is 150 pounds per horse power capacity, where the best class of steam engines is used. In the petroleum engine ·75 pound of oil will develop a brake horse power hour, so that if the boilers are replaced by an equal weight of fuel oil the radius of action for the ship is increased to correspond with 200 hours of operation for its engines at full capacity. It must be said, however, that the development of very large oil engines, such as would be required to drive warships, is in the experimental stage, and the hopes now held for them may not be realized. Concerning the advantages of petroleum fuel for steam boilers there remains, however, no doubt whatever. It may be mentioned here that the so-called petroleum engines do not use the crude oil, but usually those products of distillation that are obtained at temperatures of 340° to 476°F. This part of petroleum, known as the illuminating oils, constitute about one-half of its total weight. The amount of coal consumed by navies is known to be very large, and it may be questioned whether the supply of petroleum is sufficient to permit its use for fuel under their boilers.

During the year 1898 there was produced in the United States petroleum to the amount of 8,500,000 tons. Allowing a large warship to consume 7,000 tons of coal per year on an average, the 8,500,000 tons of petroleum, with a heating power equal to 12,800,000 tons of coal, would supply 1,800 such ships. As it would be impracticable to devote the entire output of petroleum to naval purposes, the number of war vessels that could be supplied from present production in the United States would be a mere fraction of that just named. Unless the rate of petroleum production is very largely increased, it is quite evident that this desirable fuel cannot be generally and constantly used by the navies of the world. The great advantages to fighting ships of petroleum, in times of war, seems to indicate that naval powers will come to regard large natural deposits of this fuel with jealousy, and accumulate great stores of it at their coaling stations. Since petroleum may be used alternately with coal under the same boilers, it may well be that coal will continue to be the principal fuel for navies during times of peace, while petroleum is held in reserve for actual war. The commercial demands for petroleum are already tending to develop new fields of production, and its recognition as the most effective fuel for warships is sure to hasten this process. Petroleum is now produced on a very large scale in only the United States and Russia, and the export trade is carried on almost exclusively from these countries.

Deposits of petroleum in greater or less amounts seem to be almost as generally distributed as are those of coal. Most of the countries of Continental Europe produce small quantities of petroleum for home consumption, and in Germany and Austria the supply is quite large. The oil from Scotch shales is sufficient for only a small part of the demand in Great Britain, where the annual import of the distilled products of petroleum is nearly 200,000,000 gallons. China and India have long produced some petroleum and are believed to have large deposits. Several islands of the Far East, as Japan, Borneo, and Java, are said to promise future supplies of petroleum. In the Western Hemisphere vast quantities of petroleum are believed to exist in Canada, Mexico and several of the countries of South America. When these undeveloped fields are in operation, the supply of oil may be as plentiful as that of coal, but this seems improbable. Meantime petroleum fuel is being applied in some recent war vessels of Russia and the United States, with a decided increase of speed over that attained with coal. So long ago as the time of Admiral Selwin, petroleum was shown by the British Navy to be a superior fuel. But it yet remains for Great Britain to take any definite steps for its general use. Merchant ships do not find the advantages of petroleum so important as do vessels of war, because steaming radius or rate of speed in the latter may determine the result of a battle or the fate of a nation For the same cost of equivalent heating power, crude petroleum at 4 cents per gallon equals steam coal at $7.32 per ton. Petroleum must, therefore, be materially reduced in price before it becomes the general fuel for merchant ships.

OPERATION ON THE XIPHOPAGES.

We have already mentioned the fact that the xiphopage twins whose portraits were published in the SCIENTIFIC AMERICAN for February 24, 1900, have been separated by a surgical operation. We give a full account of this operation in the SUPPLEMENT for the current week. One of the most distinguished physicians in Brazil, Dr. Prevost, separated the eight-year-old twins, Rosalina and Maria, but we regret to say that one of the twins, Maria, died from the effects of the operation. The operation was performed on May 30 in the operating room of the St. Sebastian Hospital.

Before the operation, while under the inspection of the surgeon, Rosalina had an attack of grippe which lasted eight days, while Maria remained well. This confirmed the surgeon's opinion that there was no psychological condition which forbade their separation. The children were chloroformed separately and the operation, which is fully described in the SUPPLEMENT, was performed. It required two hours, and when they came out from under the influence of the anæsthetic, each asked where the other was and when they realized that they were separated and still alive they exclaimed, "Oh, Doctor, how good you are." On the seventh day Maria died and the post-mortem examination showed that death was caused by inflammation of the pleura. Rosalina continues to improve.

THE Roentgen Society of the United States will meet in New York City, December 13 and 14, 1900, at the Academy of Medicine. Addresses have been promised by eminent men at home and abroad, and a successful meeting is assured. Visiting members may obtain information in X-ray work. It is especially desired that all those who are using the X-ray in any way, either professionally or experimentally, send their names and addresses to the chairman of the Committee of Arrangements, Dr. S. H. Monell, 45 East Forty-second Street, New York city. The Society is the only one of its kind in America and is for scientific purposes only.

A NOVEL ENGINE FOR DIE-SINKER'S USE.

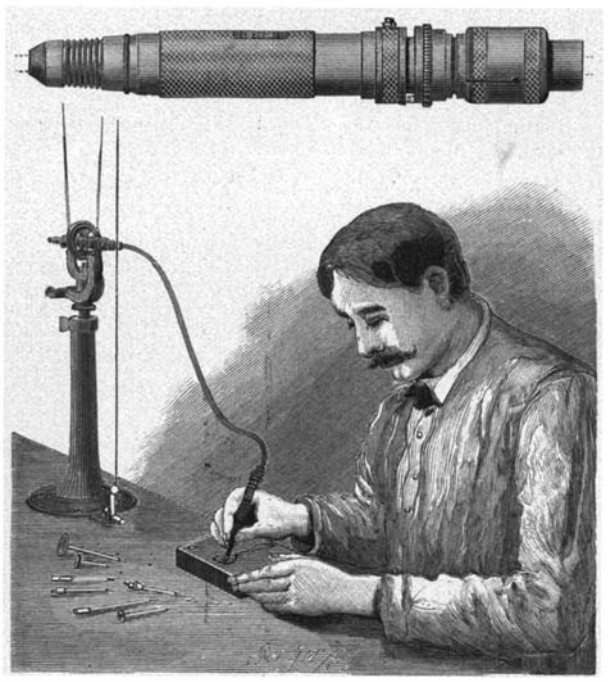
In the making of dies, perhaps the greatest difficulty is experienced in finishing. Riffling-files fail to touch the spot properly; specially bent files are equally inadequate; and even the ingenious expedients to which the experienced die-sinker resorts fail. Like most manufacturers who are makers of dies, the S. S. White Dental Manufacturing Co., Chestnut Street corner Twelfth, Philadelphia, Penn., have found it more than usually expensive and arduous to finish dies properly. The company determined, after many special tools had been tried, to use a modified form of its dental engine, the exceedingly flexible working arm of which seemed well adapted to the work of die-sinking. The trial proved a complete success; no trouble whatever was experienced in quickly reaching and finishing any part of the most intricate dies. Further experiment finally culminated in the manufacture of an engine by means of which the die-sinker is enabled efficiently to perform the most difficult work in this art.

In its general construction the machine is an S. S. White dental engine modified and strengthened to meet the requirements of the die-sinker. The main feature of the whole apparatus is the ingenious arm employed, which is a power shaft perfectly flexible, revolving as freely as a straight shaft, so that the full power is transmitted to the working end. This highly flexible arm consists of a tempered steel wire cable, so wound that it maintains its tension without straining or uncoiling, rigid ends being provided for the attachment of a pulley, hand-piece, and tool-holder. A woven sleeve protects it throughout its length.

Two such arms are employed, the one (used for light work) for carrying tools whose shafts are 0·092 inch in diameter; the other (for heavier work) driving a coarse grinding wheel 1¾ inch in diameter and ¼ inch face, or a cutter or drill in steel to about $\frac{3}{16}$ inch diameter. Since the threaded connection for the bench stand are interchangeable, either arm can be quickly substituted for the other.

A convenient holder for the hand-piece is formed by a forked rest secured to the engine stand. At the opposite end of the rest is a lug which engages the pulley and acts as a clutch when the hand-piece is in the rest, thus preventing the arm from being thrown out of its place by the accidental starting of the engine.

In the making of many dies, after the milling-cutter and chisel have been used, much finishing remains before hardening, which, heretofore, could be accomplished only by means of riffling-files and emery sticks. It is at this stage of the work that the engine saves time and labor. In correcting the distortions caused by hardening and tempering, and in quickly removing the wrinkles formed in many drop-forging dies, without drawing the temper or even taking the die from the drop, the flexible arm is also exceedingly serviceable.



A NOVEL ENGINE FOR DIE-SINKER'S USE.

ELECTRICAL TOP AND MOTOR.

BY HOWARD B. DAILEY.

Although slow in finding place among the world's important commercial utilities, static electricity has long occupied in experimental physics a realm of peculiar and fascinating interest.

Very beautiful are many of its phenomena, and especially striking are some of the effects of electrical attraction and repulsion, those mysteries of nature, whose early manifestations were the basis of the first historic electrical experiments. The apparatus here described furnish most pleasing illustrations of dynamic action within a static electric field, and in a novel manner exhibit these subtle forces at work.

The static electric top is an experiment of singular beauty, and well repays the amateur for the slight labor its simple construction entails. The top proper is in a disk of stiff mica, 4⅝ inches in diameter, mounted between two small buttons of wood or vulcanite upon a short piece of stout knitting needle. The lower end of this steel spindle, which is sharp pointed at both ends, projects nine-sixteenths of an inch below the disk; and rests, when the instrument is in operation, in a little indentation worked with the point of a file in the upper end of a vertical glass support rising from the center of a mahogany base. For the sake of ornament several concentric circular stripes may be painted upon the top with a solution of red sealing wax in alcohol.

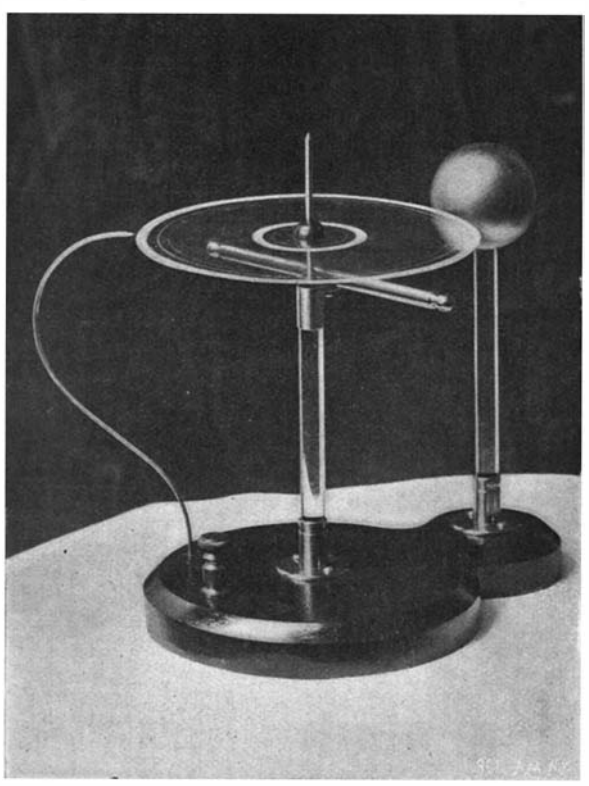
The disk, whose edge should be made to run true, must be carefully balanced, if necessary, with a bit of wax, attached to its surface. A second insulated standard, seen at the right in the figure, carries a gilded wooden ball, 1½ inches in diameter, fixed at a distance from the central support just sufficient to avoid contact with the top's edge in its rockings to and fro. A brass wire, shown at the left, rises from the base and presents a sharpened end to the edge of the top at a point distant from the ball about one-third the circumference of the disk; the wire being curved well out away from the top's lower side and made to approach its edge in a horizontal direction. Finally, at the top of the central glass pillar on the side nearest the ball, is fastened horizontally a piece of quarter-inch polished brass rod, with rounded ends and of a length about equal to the diameter of the mica plate. The angular adjustment of this induction rod, whose place is normally about half an inch below the mica disk, has much to do with the speed and stability of the top. Its best position must be determined by experiment; however, that indicated in the diagram will be found nearly correct. *D* is the mica disk; *b*, the electricized ball; *p*, place at which the wire point approaches the disk; *r*, the brass induction rod; the wire point and rod making respectively angles of sixty and seventy-five degrees with a line, *l'*, through the centers of disk and ball. The rotation will be in the direction of *a*.

To start the top, a wire from the negative pole of a Wimshurst machine—from that side which gives the brush effect on the collecting combs—is inserted in a small hole in the ball; the brass wire discharge point is connected, through a binding post on the base, with the opposite side of the generator.* The disk, then held lightly in position for a few seconds with a finger placed upon the pointed upper end of its handle, immediately begins a swift rotation; when the finger may be removed and the top kept in motion by the forces at work within the electrostatic field—will spin continuously as long as electrical excitement is maintained. In working the Wimshurst some care must be taken not to supply too much current, as sparks or brush discharges across the instrument are not desirable; also, to guard against deleterious effects from outside inductive influences, the top should be removed some distance from the plates, conductors, etc., of the machine.

As an interesting variation of this experiment, the neat static motor is shown. A 4½-inch mica disk has the pivot-pointed ends of its spindle fitted loosely into indentations near the tops of two upright posts of polished brass. An insulated brass ball placed opposite the horizontal diameter of the disk as closely as possible to its edge, and the pointed conductor rising from the ornamental brass post attached to the vulcanite base at the right, complete the arrangement. The ball and discharge point being connected respectively with the opposite poles of a static machine in operation, the mica plate revolves at a speed of nearly 2,500 revolutions per minute; and, since the force with which it turns is considerable, light machinery may be driven from the small grooved hard rubber pulley upon the shaft. As either of these experiments is obviously but a modification of the other, the theory of operation is essentially the same for both, and will be readily understood by any one familiar with the principles of electrostatics.

In the case of the top, that portion of the disk opposite the curved wire receives along its edge and adjacent surface strong positive electrization, causing repulsion from the point with simultaneous attraction by the negatively excited ball. Rotation ensues, charged sections of the mica arriving at *b* and yielding up to it their positive electricity, receiving negative instead in a hissing stream of small sparks. Passing by, these parts are now strongly impelled forward by repulsion from the similarly charged ball, until, coming within the attractive influence of the positive wire, the cycle is repeated. The rotation is probably aided in some manner by a current of air—"electric wind"—which blows from point to ball across a portion of the disk in the direction of its motion. The precise nature of the influence exerted by the metallic rod below the disk is somewhat obscure. Its presence seems to effect through some inductive process a certain necessary balancing of the acting forces; without it the top indulges in violent gyrations and soon tumbles off. These instruments demonstrate to excellent advantage the mechanical action of static electricity, and will be found valuable adjuncts to the static machine.

* This wire, with its binding post, might, with some advantage, be insulated upon a short vulcanite support.



ELECTRICAL TOP.

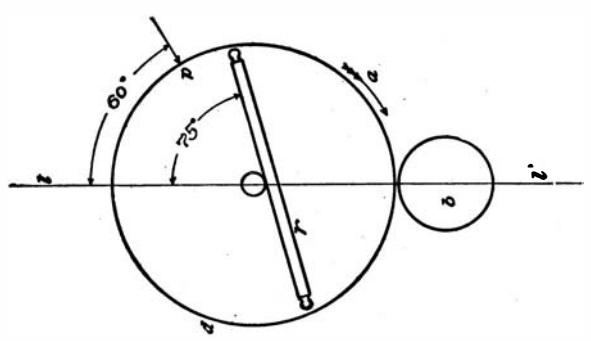
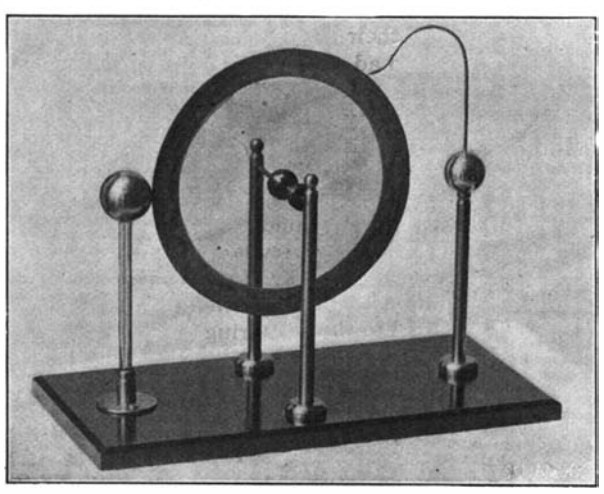


DIAGRAM OF ELECTRICAL TOP.



STATIC MOTOR.

Experiment Stations in Hawaii and Porto Rico.

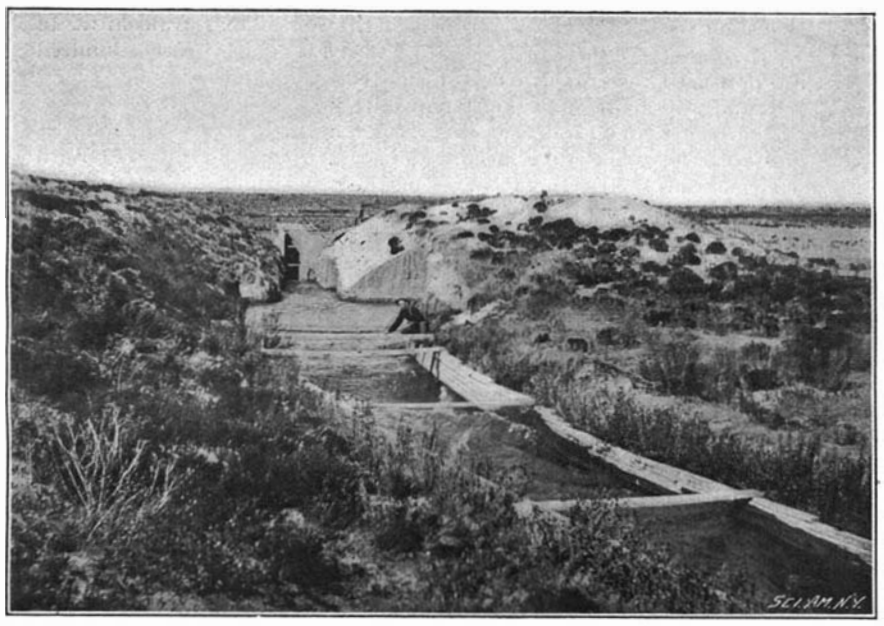
Congress has appropriated funds for the inauguration of agricultural experiment stations in the islands of Hawaii and Porto Rico. Prof. S. A. Knapp, of Louisiana, has been selected to investigate the agricultural conditions and possibilities of Porto Rico. He went to the island in June, and will study the lines of experimental investigation which should be undertaken there, locations suitable for stations, and the approximate expense of inaugurating and maintaining the work. He will also look into the feasibility of undertaking co-operative experiments with the residents of Porto Rico.

Dr. W. C. Stubbs, director of the Louisiana experiment stations, will make a preliminary survey of the conditions in the Hawaiian Islands. He sailed for Hawaii about the middle of July, and will spend the month of August in the Islands. The conditions there are somewhat different from those in Porto Rico, as a station for experiments in sugar production has been maintained by private beneficence for a number of years. This will probably be a profitable field for investigation in the use and economy of water in irrigation, as probably in no other place has so much money been expended for pumping water for irrigation. In some cases the expense is as high as $125 per acre annually.

WATER MEASUREMENT AND MANIPULATION IN COLORADO.

BY H. A. CRAFTS.

Colorado cultivates more than two million acres of land, a fact made possible by irrigation alone. When it is known that this land has to be irrigated two or three times over, each season, the magnitude of the labor involved may be imagined. The State is divided into eight water districts, and each of these districts is subdivided into what are known as commissioner districts. There is a State superintendent of irrigation; but really above him in authority is the State engineer. Over each commissioner's district presides a water commissioner, who is appointed by the Governor of the State upon recommendation of a majority of the county commissioners of the counties through which the district extends.



DISCHARGE-WAY AND MEASURING WEIR OF ONE OF THE RESERVOIRS.

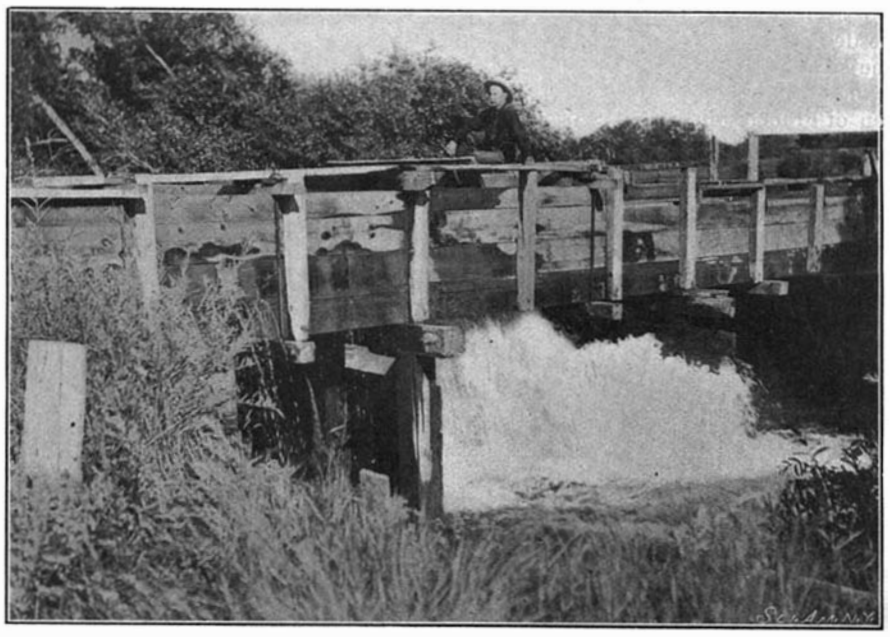
It is the duty of a water commissioner to see that the water appropriated for irrigation in his district is distributed according to the legal rights of the owners of the ditches within his district. These rights have been established by decrees of the district courts of the State, and the decrees are printed in pamphlet form for the guidance of water commissioners and others in interest. The rights of an irrigating ditch to water from a natural stream, with relation to the rights of competing ditches, is based upon the priority of appropriation. Appropriation dates from the completion of a ditch and the taking of water through it for irrigation.

The commissioner's district, covering the Cache la Poudre Valley, extends from Chamber's Lake on the west to the South Platte River on the east, a distance of about eighty miles. It includes a cultivated area of about 250,000 acres and 114 ditch priorities. The aggregate appropriation of all of the ditches is 2,400 cubic feet of water per second. The maximum flow of the river is about 7,000 cubic feet per second. In 1884, a year of high water, it discharged for a period of twenty consecutive days 5,000 cubic feet of water per second; and for a period of fifty-five consecutive days 3,000 cubic feet of water. The river is rated at a weir constructed for the purpose, just inside of the mouth of the cañon.

From these ratings the water commissioner devised a scheme which has proven quite satisfactory. As it happens, two of the largest ditches in the district are of the latest construction—the Larimer and Weld, with an appropriation of 720 cubic feet per second, and the Larimer County, with an appropriation of about 600 cubic feet per second. The head gates of both are within five miles of the rating weir, and within four miles of each other. In the bed of the river, near each of these head gates, was set a pole marked off in inches, and by using the ratings made at the measuring weir as a basis, a formula was established whereby the amount of water being discharged by the river at any given time could be determined by a glance at one of these stakes. The Larimer and Weld being senior to the Larimer County, and its head gate lower down the river, the stake located at that point is used for observation in the first instance. If sufficient water is flowing to supply full appropriations to all the ditches below, and which are also senior, then any surplus is turned into the Larimer and Weld until its appropriation of 720 cubic feet per second is filled, and then if there still exists a surplus that surplus is given to the Larimer County ditch up to its full appropriation. Above the Larimer County is still the North Poudre Canal, which is the junior of all of the large ditches on the stream, and which comes in for a supply when all the others have been given their appropriation. As the appropriations of the three ditches named aggregate an amount about equal to half of the appropriations of all, the problem of distribution can, for the greater part of the time, be solved by cutting the total discharge about in half. So long as there is sufficient water passing the head gate of the Larimer and Weld ditch to satisfy the appropriations of the senior ditches, the commissioner does not worry himself about them; each ditch gets its full appropriation, and that is the end of it. Occasionally there is complaint that some ditch is taking more than belongs to it, in which case the commissioner has to make an investigation and correct the abuse, if there is one. But should the water fall below the point mentioned, then he must call down the junior ditches in their order, until the senior ditches have their full rights.

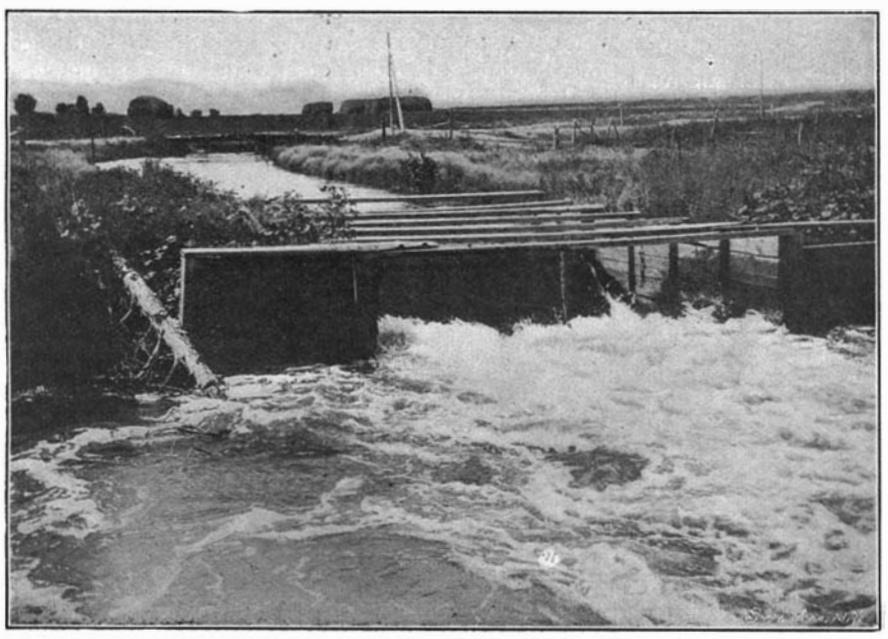
The larger ditch companies run their ditches in sections, having a ditch rider for each section. The water of the river is distributed twice a day during the irrigation season—morning and evening. This keeps the superintendents informed of the amount of water their respective ditches are entitled to. Upon this information the superintendent predicates his orders to his subordinates, who are thereby governed in their distribution of water to consumers. The water is kept running in the ditches, night and day, all through the irrigating season. During the daytime the farmers and their hands distribute the water over their land. At night, the hours of which are made very short by the irrigator, and on moonlight nights some farmers remain out irrigating all night. The water is turned upon some level portion of the farm, where it will cover the ground of its own volition. In times of low water it is not uncommon for two large ditches to work on the exchange plan—that is, one ditch for a certain number of days will take all the water that the two are entitled to, and then give the other its turn under a like arrangement. It has been found that water will go much further under this plan. The storing and distributing of water for irrigation involve many interesting features. Take the Chamber's Lake reservoir of the Water Supply and Storage Company, as one, for instance. It is situated high in the Rocky Mountain range, at least fifty miles from the head gate of the company's main ditch, but tributary to the Cache la Poudre River. When the water stored up in it is needed for use at any time, it is measured into the main current of the river and permitted to run its course. As an equivalent the company is allowed to take from the river at its head gate an equal amount, less a small deduction made for leakage and evaporation on the way down from Chamber's Lake. The using of the natural bed of a stream for the conducting of water for irrigation, as just described, is permitted by a State law.

The manipulation of the water stored in the plains reservoir of this company affords another instance of ingenuity. These reservoirs consist of a chain of six artificial lakes some seven or eight miles eastward from the company's main head gate. The lakes were formed from natural depressions in the land, diked up, and are filled annually through the company's main ditch. But they are so situated that they cannot be drained into the main ditch and the water carried forward to the land desired to be irrigated, nor can they be drained by independent outlets that can be made to reach such land. So the water can only be utilized by means of an exchange with older ditches that lie at a lower level than the reservoirs. The total capacity of these reservoirs is in the neighborhood of 600,000,000 cubic feet of water, so it can be seen that the utilization of the water thus stored is a matter of no small importance. The reservoirs are all connected by canals, and can all be drained, one into another, until the last one is reached. The exchange of water is made both with other ditches direct and with the river below. An exchange is frequently made with the Larimer and Weld ditch, the discharge-way of the reservoirs crossing the ditch in a flume at right-angles, and through the bottom of this flume the water is dropped into the ditch below, as shown in one of our illustrations. When it is not convenient for the Larimer and Weld to take this water, it is carried on into the river, being measured near the discharge-way of the lakes by a weir, as is also shown in another of our illustrations, and the owners of the reservoir permitted to take an equal amount of water from the river above, at their head gate. There is nothing compulsory about this exchange, but it is made by mutual agreement among the ditch companies.



LARIMER COUNTY DITCH DROPPING RESERVOIR WATER INTO THE LARIMER AND WELD DITCH IN EXCHANGE FOR RIVER WATER.

The Larimer and Weld has a large storage reservoir near its upper extremity, which is so situated that it can be drained directly into the main ditch, and the third of our illustrations shows this being done.



LARIMER AND WELD DITCH, DRAWING WATER FROM ITS TERRY LAKE RESERVOIR AND DELIVERING IT INTO ITS MAIN DITCH.

Automatic Development of Photographic Plates.

A method of automatic development has been devised by which each plate is coated on the back with the necessary products, and the development is carried out in water which has been made slightly alkaline; this may be of advantage to tourists, as it avoids the carrying of chemicals. The formula for the solution is as follows:

Pyrogallic acid	10 grammes.
Salicylic acid	1 "
Dextrine	10 "
Alcohol	4 c. c.
Water	20 "

The solution is spread upon the back of the plate and allowed to dry. The exposure is made as usual, and, to develop, it is sufficient to put the plate in water to which a few drops of ammonia have been added, The coating dissolves and the developer is thus prepared.

THE PARIS EXPOSITION.

The Paris Exposition may be really said to open at the two Palaces of Fine Arts. The visitor passes along paths bounded by beautifully kept flower beds until the Avenue Nicholas II. is reached. This broad avenue leads from the Champs Elysées to the Alexander III. Bridge, and serves to separate the two Palaces of Fine Arts. These buildings are of particular importance, owing to the fact that they are permanent structures being built with special reference to solidity and they are, of course, entirely fireproof. After the Exposition shall have closed its gates, they will be used for the annual saloons and other exhibitions. The old Palace of Industry was moved to make way for the larger palaces. Both of the edifices bear the name of their architects, the larger of the two being known as the Palace Deglane and the smaller as the Palace Girault, and their style is that of Louis XVI. The Grand Palace is most imposing with its big colonades and pediments in the middle profusely decorated with sculptured figures and groups. The large number of columns in the porch and the façade balances the somewhat exuberant ornamental detail. The glass roof which covers the great courtyard can hardly be seen from the avenue and, therefore, it does not produce the discordant note which it might be expected to do. The grand entrance hall is 660 feet long and 180 feet wide. Beyond this vestibule is the annex or prolongation of the hall, which is reached by an ornamental staircase of wrought iron. On the first floor are various galleries arranged as places of general reunion, and surrounding the exterior of this hall is another gallery 1,100 feet long and 40 feet wide, and above the whole edifice rises the dome 141 feet high. At the summit of the staircase is a grand concert hall capable of seating 1,500 persons. The two lateral façades are curved, producing an effect which is not liked by all architects. The shape of the annex is also unfortunate, as its axis follows the Avenue d'Antin; this last section being designed by M. Thomas. It contains a large hall, surmounted by a low dome and is devoted to sculpture. The posterior façades are decorated with massive plaques made at Sevres. The space in this vast building is divided between France and foreign nations, and the decennial exhibition of French works of arts occupies by far the largest space. Each country has been given a free hand to decorate its own sections as it pleases. The rooms, owing to an ingenious method of slanting the glass roof, have an equal light distributed on each wall, and their different dimensions are equally suitable for works made for close inspection as for those that are most striking at a distance. Some of the rooms are vast in size, where canvases 50 feet in height may easily be shown.

The small Palace of Fine Arts is devoted to a retrospective exposition of French art, and it consists of a vast number of objects illustrating art in France, from the earliest ages to the present time, including ivories, bronzes and iron work. Here are ceramics, woven stuffs, leather, jewelry, glass and mosaic, coins, manuscripts and printing. A suite of rooms furnished in various styles succeed each other and are well worth studying. The Centennial Exhibition of paintings are really a second part of the retrospective exhibition, and are housed in the large palace.

The means of getting around the Exposition are, on the whole, not of the best, for there is no way of going from the Palaces of Fine Arts to the Invalides section, or the other sections, without walking or taking a wheel chair. Between the Invalides section and the Palaces of the Nations and the Champ de Mars section there are, however, two excellent means of transportation—the moving sidewalk and the electric railway. The moving sidewalk consists of a fixed platform, and two moving platforms working at different speeds. The movable platforms move at the rate of 2¼ and 4½ miles an hour respectively, present the appearance of endless ribbons each independent of the others, and are constructed with a short truck without wheels, supported by the two trucks, which are supplied with four wheels. Under each truck is fixed a kind of rail, the ends of which are joined to those of the next truck. The wheels of the trucks run on rails secured by plates secured to wooden sleepers. Each truck carries a motor. Hand rails are placed at regular intervals to assist passengers in crossing from one platform to another. The length of the platform is 11,054 feet. It is connected with the ground by footways and certain passages leading direct to the first floor of the pavilion. There are eleven stations and the fare is ten cents per trip, not exceeding one complete circuit. One of our engravings shows the moving platform at the rear of the Italian Pavilion. It is also shown in our second engraving, although the electric railway is the principal feature of the picture.

The electric railway is intended to enable visitors to move in an opposite direction to the sliding platform, three cars capable of conveying about two hundred persons forming the train, and electricity is delivered to the motors by means of a third-rail. The trains follow each other at intervals of two minutes. The circuit is completed in about twelve minutes, including stoppages. The trains follow almost the same route as the moving platform, generally passing under its supporting pillars, and forms a complete circle. In order to avoid interfering with traffic in streets and avenues it runs at times through tunnels and again over a viaduct. There are five stations, one of which is shown in our engraving. This is the station at the Palace of Electricity, situated on the Avenue de la Bourdonnais. It shows the enormous span of the old Building of Mechanics of the Exposition of 1889, which is now used as the Electricity Building. In the background will be seen one of two the great monumental chimneys which may be regarded as, perhaps, the most successful attempt ever made to render so prosaic a construction as a chimney into a thing of beauty.

We have already given some illustrations on other occasions of the Street of Nations on the banks of the Seine, between the Invalides and the Champ de Mars section, and we now illustrate five more of them. Beginning at the left we have the Pavilion of Great Britain, which is on the plan of a typical English country house, being copied from Kingston House at Bradford-on-Avon, built in the seventeenth century. It is of red brick with large mullioned windows, and has been decorated by a London firm. A long gallery on the upper floor is hung with fine examples of pictures of the English school. In a basement is a very complete exhibition of English fire engines and appliances.

The Belgian Pavilion is much more imposing and its exterior is built in the Flemish style, reproducing the best portions of the same of the celebrated town halls and municipal buildings of Belgium. The central tower is an exact reproduction of the Hôtel de Ville at Andenarde. The building contains various exhibits and reception rooms. The Norwegian Pavilion is built in the style of the châlets in Christiania and is entirely of Norwegian wood, and is painted red. The ground floor contains a valuable collection of fishes and fishing appliances. The upper floors contain picture galleries and exhibition rooms.

The German Pavilion is a very gay affair, suggesting the building exhibited at Chicago in 1893. It has been aptly described as a "synthesis of ancient and modern German architecture." There is a reminiscence of Nuremberg, and the Rhenish towns, and of Berlin and Munich. The façades are all different and the building is crowned with gables, tourelles and clock towers. The building contains an important exhibit of German books and in the basement is a "rathskeller."

The Spanish Pavilion is a pleasing representation of the Castilian Palaces in the days of Spanish grandeur. It is square, with a tower at each angle. There is a valuable collection of armor, known as that of Charles V., exhibited in the building. Farther on down the Seine are the Greek Palaces, Swedish Pavilion, Palace of Servia, Palaces of Roumania, Bulgaria, Finland, Luxemburg, Persia, Peru, Portugal, and Denmark.

The Murray High-Speed Page-Printing Telegraph.

Mr. Donald Murray, an Australian inventor, has recently sold to the Postal Telegraph Company his patents for the United States for a new device for the mechanical transmission of telegraphic messages. It is expected that the system will come into general use within the next few years.

Mr. Murray's invention consists in combining a recording instrument having a series of movable character levers, an electromagnetic perforating instrument, and a tape or strip of suitable material, like paper, which passes through the paper and recording instruments in succession. With the Morse telegraph key, about fifty words can be transmitted a minute, and using the Phillips code as many as sixty-five or seventy words can be sent a minute. Of course, the trouble has been the physical limitations of the human operator, and Mr. Murray does away with this difficulty by automatic transmission. By his system a message is produced on a narrow paper ribbon by means of perforations which correspond with the Morse alphabet. A line of circular feeding holes keep the tape in alignment and also serve to feed it. The tape is run through a perforating machine manipulated by keys like a typewriter, making the necessary transmitting holes. The tape containing the message thus indicated is then put into a Wheatstone transmitter, which is driven by a small electric motor, which is kept running at a uniform rate by an electric vibrator. A receiving instrument at a second station records the electrical impulses determined by the perforated tape in the sending instrument, and on a tape similar to that used at the sending station. This reproduces the perforations representing the letters of the message. The receiving tape is then put into a most ingenious instrument, which is connected with an ordinary typewriter. The tape runs over a small wheel provided with metal points, which serve to feed the tape by the line of feeding perforations. Five rods press against the tape and serve to control the operations of the levers, which in turn control the type keys. As the tape passes these points, some of them slip into the perforations representing each letter. The points which do not enter the tape perforations release the particular key in the typewriter, which will print the proper letter. The typewriter can be operated by a crank or by a motor, and the message is clearly printed on a telegraph blank, the type bars working at a rate exceeding that of manual operation. By the new system a message can be divided between several operators at the perforating machine, and the several strips of perforated tape are then run into the Wheatstone transmitter in their proper order, so that a message of nine hundred words can be transmitted over the wire in eight minutes as against half an hour. A speed of a hundred and fourteen words per minute, over a distance of 388 miles, has been attained with this instrument. With Mr. Murray's system, the tape which has been perforated at the receiving station can be put directly on to an attachment applied to a linotype machine. The message contained in the perforated tape, instead of being typewritten, can then be actually converted into type by means of the linotype mechanism. News copy transmitted may be typewritten in the newspaper office by the automatic machine and this may be then used as a guide by the linotype operator, and excisions, corrections, or additions may be made without interrupting the automatic operation of the linotype machine, except when the matter is changed.

Automobile News.

A large department store in New York city has what is termed an "Automobile Annex," where vehicles are shown, and an Otto gas engine belted to a dynamo serves to charge vehicles which may be brought to the annex for that purpose.

M. Pierre Baudin, Minister of Public Works, is preparing a list of all the paved roads which are now impracticable for the bicycle or automobile, within a radius of 40 miles around Paris. According to the indications thus furnished, which are to be checked up on the spot, he is to commence a series of improvements in the roads, beginning with those which seem to be the most urgent or offering more interest for touring or circulation.

The De Dion Company, of Paris, has recently built its first electric automobile, and it appears that the results of the test have been quite satisfactory. The same company is furnishing the tests of a new racing quadricycle on the petroleum system; it is very light, although possessing a motor of about 12 horse power, which gives it a great speed. The works at Puteaux, on the Seine, manufacture, besides moto-cycles, launches operated by petroleum motors, a steam omnibus of a new type, etc.

The municipal authorities of Riegelsburg, near Saarbruck, Alsace, propose to establish an automobile service between the town and the center of Saint-Jean-Saarbruck, a distance of six miles, and have advertised for offers of eight place vehicles; these are to be hired at first for six months, and may then be purchased if found suitable; offers are to be addressed to the burgomaster of the town. At Charlottenburg, near Berlin, an electric omnibus is now in circulation, which can transport seventeen persons, eight in the interior and nine on top. The electrical energy is furnished by two batteries of accumulators weighing 1,100 pounds. The omnibus makes a course of 30 miles without recharging.

Consul-General Guenther writes from Frankfort, May 25, 1900: The Automobile Company of Speyer, organized last year with a capital of $24,000, has five automobiles in use, representing an investment of about $14,500. They are propelled by a benzine motor in front of the vehicle of 10 horse power, and were built by the Daimler Automobile Company, of Cannstadt. Each coach is capable of carrying twenty-eight passengers, and the company has a contract with the Post Office Department to carry the mails (which include packages, etc., usually sent by express in the United States) to Dudenhofen, Geinsheim, Honhofen, Harthausen, Mechtersheim, Otterstadt, and Waldsee—two to ten miles away. In the five months since starting, more than 40,000 passengers have been carried.

The Belgian Moto-Club is now definitely organized, and has appointed a committee to enter into relations with the Moto-Club of France, especially with regard to the adoption of regulations. Persons desiring to join the club should address M. G. Jacobs, Hotel Métropole, Place de Brouckère, Brussels. At the same time, the Belgian Automobile League is being formed; it is especially a touring organization, having for its object custom-house reforms, improvement of roads, and the establishment of supply stations containing petroleum and of charging posts for electrical vehicles; it will also organize tests and races, and found a training school for conductors of automobiles. The Automobile Club of Belgium is organizing a series of touring races which will cover the entire country; it will be carried out somewhat on the same lines as the tour of England, and will last from ten to twelve days, during which time all the important localities of Belgium will be visited, and automobile expositions of short duration will be held.

Science Notes.

The City of Newark, N. J., is planning a State Industrial Exposition to be held in their city in 1902.

This has been a record-breaking year for the California orange crop. The yield will, it is thought, be about 4,500,000 boxes, or 14,500 carloads. The total investment in California orange groves now amounts to $44,000,000.

Dr. J. H. Breasted, Professor of Egyptology in the University of Chicago, has just been appointed by the Emperor of Germany to superintend the publication of his new Egyptian dictionary. This lexicon will enable students of Egyptology to study the hieroglyphics in the museums throughout the world. This is an excellent compliment to an American scholar.

M. Tissot has succeeded in increasing considerably the sensitiveness of the coherers which he is using in his experiments in wireless telegraphy; the coherer is placed in a magnetic field, whose lines of force are parallel to the axis of the tube. Filings of steel or nickel oxide are used. The system of aerial telegraphy which he now uses enables him to receive signals from the cruiser "Massena" at a distance of 20 miles, with a mast of only 90 feet.

Mr. Albert Wilde, of the Royal Society of Great Britain, has been presented with the Society of Arts Albert Medal. This is a most highly prized trophy, and is awarded for momentous discoveries in science. In the present case it was awarded to Mr. Wilde "for the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small." The modern dynamo is based upon this principle, and it is adopted in all modern dynamos.

The Peary supply ship "Windward" sailed on July 20 from St. Johns, Newfoundland and her return will be watched for with great anxiety, as she will be the bearer of news of Peary's success or failure. The "Windward" carries a crew of thirteen, and Mrs. Peary, and her little daughter also go to join Lieut. Peary. The boat is loaded to its utmost capacity with coal, even the decks carrying it. The objective point of the "Windward" is Etah, this being the center of the region where are located the Arctic Highlanders, a tribe of Esquimaux who live farther north than any other human beings.

The printing of books with Braille type for the benefit of the blind has made immense progress in England within the last few years. The Central Lending Library, of Birmingham, has no less than five hundred books printed with Braille type. This extensive library comprises the works of such favorite authors as Shakespeare, Browning, Sir Walter Scott, Tennyson, and Ruskin. The Plymouth Public Library has also a similar collection of about two hundred and fifty volumes, and numerous other libraries throughout the country possess similar collections for the entertainment of those deprived of their sight.

The engineer in charge of the improvement of the Yellowstone Park denies that the geysers are approaching extinction. An article to this effect appeared in a French paper and was widely copied throughout the United States. It tends to create an impression that the Yellowstone wonderland, as far as regards the hot springs and geysers, is practically a thing of the past. This is an excellent example of how a scientific observer may draw a wrong conclusion, if he has not studied the subject sufficiently. The names given to such natural objects as geysers are very apt to be misnomers. The geyser action on the shore of Yellowstone Lake is more vigorous than it was ten years ago.

The Council of the American Chemical Society has passed resolutions favoring the creation of a Bureau of Chemistry. The laws of the various States controlling food adulteration are largely ineffective, because of the interference of interstate commerce laws, and can be made effective only through national legislation. Bills are now pending which propose to establish in the United States Department of Agriculture a Bureau of Chemistry, the Director of which shall, under the direction of the Secretary of Agriculture, be charged with the chemical investigation of the foods produced and consumed throughout the country. The American Chemical Society desire to urge the enactment of the bill into a law.

Prof. G. J. Peirce contests the current view that the connection of the fungus (hyphal) and the algal (gonid) elements in lichens is one of commensalism. The hyphæ and the gonids are in the most intimate contact with one another; the hyphæ develop branches which may merely clasp the gonidial cells, or may penetrate them in the form of haustoria. This clasping or penetration stimulates the gonids to internal cell-divisions. The haustoria consume the protoplasmic contents of the gonidial cells which they have entered, leaving only the empty cell walls. The fungus is fed by the alga, and there is no evidence that the gonids develop more luxuriantly in connection with the hyphæ than they would elsewhere.—Proceedings of California Academy of Science.

Engineering Notes.

A mail train on the New York Central Railroad recently made the run from Rochester to Syracuse, eighty-one miles, in eighty minutes.

The underground railways of London carry only nineteen per cent of the passenger traffic; eighty-one per cent is carried by omnibuses and street cars.

A German method of constructing large balance wheels for high peripheral speeds consists in making the rim by winding a rectangular-section steel wire on a cast-iron spool.

The Southern Railroad Company of Italy is going to have built 18 locomotives, 121 passenger cars, 32 baggage cars, and 1,000 freight cars. Foreign concerns will be allowed to compete.

On June 30, 1900, there were 72 warships under construction in the United Kingdom, 54 being for the British Government. Sixteen of the vessels are being built in Royal Dockyards and the remaining 56 in private yards.

It is considered very doubtful if the Pennsylvania Railroad will adopt nickel steel rails for the points of severe service. At the famous Horseshoe Curve the nickel steel rails have been replaced by those of the ordinary steel type, for it was found that the rails diminished the tractive power of the engines on account of their hardness.

Mr. William H. Young, of Troy, N. Y., has been the treasurer of the Rensselaer Polytechnic Institute for half a century, being nominated to that position on February 5, 1850, vice Day O. Kellogg, resigned. During Mr. Young's administration more than 1,000 students have been graduated and more than $2,000,000 have passed through his hands. He is now in his eighty-third year and his connection with the affairs of Troy's great engineering school will always be remembered as one of the most remarkable terms of office in any institution's history.

A curious railway accident occurred in India lately. While a train was in Ruxaul Station a terrific storm commenced, and, although the brake was applied in the van and on the engine, the force of the wind was such that the train was driven along the line. The engine dashed through the buffer stop at the end of the line, and traveled along about six lengths of rail laid end to end without fish-plate fastenings. After leaving these rails the engine plowed along the embankment, and then came fortunately to a standstill, no great damage having been done.

In a paper on "Fly-wheel Explosions" read before the American Association for the Advancement of Science, the author, Mr. C. H. Manning, gave some figures relating to wood-rimmed wheel for this purpose. He stated that for the same weight, pine wood has a much greater tensile strength than cast iron, and is, therefore, much safer for a fly-wheel. An experience of ten years with many such fly-wheels has satisfied him that for engines running at a speed of 100 revolutions per minute or less, a properly constructed wood-rimmed fly-wheel is much the safer. Some twenty wheels, ranging from 20 feet to 30 feet in diameter, and from 30 inches to 120 inches on the face, have been built, and in no case have they given any trouble.

One of the greatest difficulties to be contended with in the practical applications of liquid air is that of keeping it for a length of time. According to Mr. Carl Linde, small quantities may be preserved in well-exhausted and silvered double-walled glass vessels for a relatively long time. One liter of liquid air requires for its evaporation in such a vessel about fourteen days. The ordinary sheet-iron vessels used industrially, holding about fifty liters, and covered with felt or wool, allow about two liters to evaporate hourly. Experiments are being made with a view of building large double-walled and silvered sheet-iron holders, and we may expect that holders will be constructed in which the evaporation will be not more than one per cent per hour.

The New York Fire Department now has 12 engines with rubber-tired wheels, and one of the fire trucks has also been equipped with rubber-tires as an experiment; the truck with its crew weighs about six tons. In 1897 the first engine was provided with rubber-tires. They were made of a uniform size on all four wheels, the rubber being about 3½ inches across the base within the channel of the steel tire by which it was held. The tires are now made 3½ inches on the front wheels and 4 inches on the rear wheels, which carry two-thirds of the weight of the apparatus. The additional cost of the engine equipped with rubber-tire wheels is $400 to $450. There is less wear and tear on the apparatus, and the engines are more perfectly under control. With them there is no difficulty in leaving the railroad tracks, as the driver knows that the rear wheels will not slide on the rails, but will follow the front wheels. There is less danger of collision. Many fire engines and hose wagons have been provided with rubber-tires in the boroughs of Brooklyn and Queens.

Electrical Notes.

It is proposed to establish communication between Zanzibar and Pemba by wireless telegraphy.

Electricity is to be used to convey passengers to the top of the Washington Monument, Washington, D. C.

An ostrich in the Cincinnati Zoological Gardens is undergoing treatment by electricity for paralysis. Under this treatment the bird has been able to swing first one leg and then the other.

Two more vessels of the British Navy, the "Diadem" and the "Furious," have been equipped with Marconi's wireless telegraphic apparatus. The receiving coil is suspended to a gaff attached to the mainmast, above the semaphore, which is the highest point on board. The apparatus is fitted to work up to a distance of 20 miles.

Small spiders play havoc with the telegraph wires in the Argentine Republic. The long cobwebs settle on the wires, and as soon as dew or rain falls they are rendered to some extent a conductor, and the effect is practically to stop the operation of some of the lines. The Government has determined to connect Buenos Ayres and Rosario by an underground cable 150 miles long to obviate this difficulty.

It has been suggested that the electric heaters of trolley cars be connected to the controller on the platform, so that when the highest speed is required the heaters will be cut out. They require some little time to cool off, so that the heating effect will be sufficient. This will reduce the demand for current by the heaters when full speed is necessary. It requires quite a percentage of the total output of the generating plant in the winter to heat the cars.

Madras is the only city in India where electricity is used as the power for street service. The tramways of Bombay are run by horse power and the streets are lighted by gas. Electricity is used only in a limited way. India would seem to afford an excellent opportunity for trade in electrical machinery and appliances. An American company is trying to get the privilege of converting the Bombay tramways into an electrically operated system.

The electric fan bids fair to supersede the punkah coolies of India. The regular price for four coolies to divide up the twenty-four hours is six cents each. With electrical fans the work can be done for one-third of the cost, and considerable inconvenience may be avoided. A writer in The Electrical World states that the day shifts of coolies do quite reliable work, but the night gang is not so satisfactory. Their duty is to pull the punkah over the bed, getting rid of mosquitoes and vermin, but the coolies attempt to get as much sleep as possible, and it is rather difficult to create activity among them. The electric fan, on the contrary, would give a reliable all-night service.

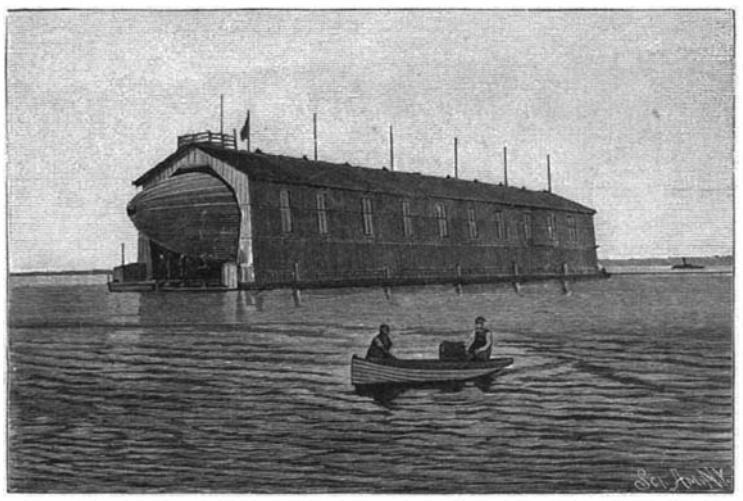
The electrical industry has been greatly developed in Germany within the past few years. In 1894 there were but 169 electric stations in the entire country, these including all kinds for the production and distribution of current for lighting and power; not more than 42,000 kilowatts were developed, the power which was supplied to fixed motors reaching only 6,000 horse power. The current was never supplied from a station for traction purposes exclusively, and accumulators were hardly ever used in connection with lighting, power, or traction. In 1899 the number of stations of all kinds reached 578, or more than triple that of 1894; the total power is increased to 224,000 kilowatts. Of this the fixed motors take 69,000 kilowatts, showing the progress made in the distribution of power. For traction purposes, 53,000 kilowatts are supplied. The use of accumulators has become general, those used in power or lighting plants representing more than 13,000 kilowatts, and this figure is greatly exceeded in traction work.

The principle of the dry battery has been successfully applied to accumulators in Germany, and the new type presents many advantages over the old form, especially for automobiles and train lighting, owing to the suppression of odors and splashing of the liquid. The plates of the battery are first connected, then put in place in the cell, and surrounded with a gelatinous mixture; they are then "formed" by the passage of current. A new method of connecting the plates is used, by which they are joined to a laminated ribbon of lead by a nut of hard lead; this arrangement is cheap and is said to be durable. The gases given off by the plates infiltrate into the upper layer of the gelatinous mass, where they are condensed and retained. The acid does not evaporate and need only be renewed at long intervals; the mass keeps the plate apart and prevents particles from falling off, and thus the plates are maintained in good condition, as has been shown by the tests made on the Berlin-Charlottenburg railway, which used them for heavy currents without being obliged to renew the plates. Two types of this accumulator are made at present, the first for the lighting of vehicles, ignition of petroleum motors, etc., and a heavier type such as has been used on the Berlin road. The latter has given satisfaction and 40 new batteries are to be used on that line.

THE ASCENSION OF COUNT ZEPPELIN'S AIRSHIP.

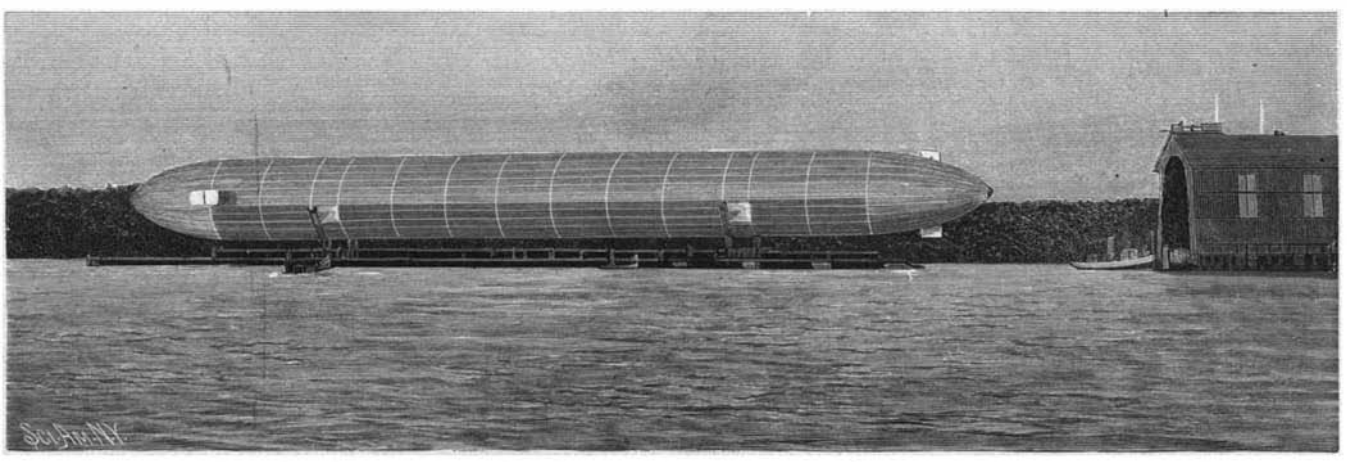
The second day of July will long be remembered by aeronauts, for on that day occurred the first ascension of the great airship just completed by Count Zeppelin, the cavalry officer of Wurtemberg, who has so long been superintending the construction of his balloon in a huge floating house on Lake Constance, a site admirably adapted for work of this kind, as it offers ample space and in case of accident the results are likely to be much less disastrous than on land.

The frame of the balloon, which is 416 feet long and 38 feet in diameter, is composed of aluminium trellis work and holds seventeen balloons of comparatively small size, thus dividing the body of the airship into compartments, an arrangement the advantages of which are quite apparent. When fully inflated, the airship will contain 11,300 cubic meters (399,059·5 cubic feet) of hydrogen gas, and will, consequently, have a lifting capacity of 10 tons. The propellers are actuated by two Daimler motors of 15 horse power each, one being placed in the car at the front of the ship and the other in the rear car. The occupants of these cars can communicate with one another by telephone. By means of a weight arranged to slide on a rod under the airship, the latter can be made to move in a horizontal or an inclined plane, as desired.

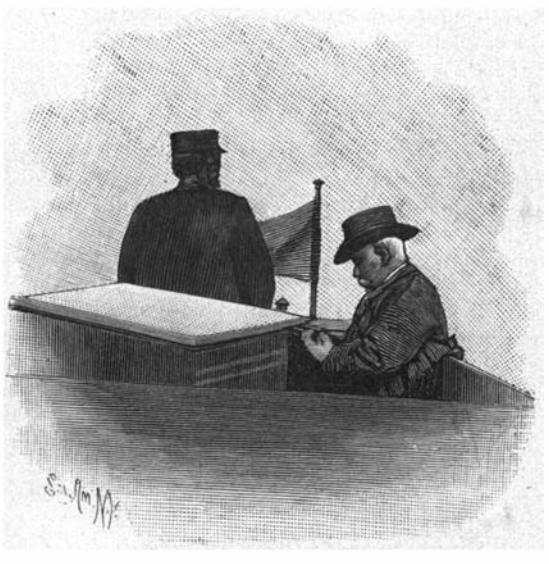


VIEW OF FLOATING HOUSE WITH BALLOON.

Count Zeppelin, like all originators of great schemes, has had many unexpected difficulties to contend with, not the least of which was, probably, a tempest which tore his great floating house from its moorings and did other damage, which was repaired only at great expense of time and labor as well as of money. Numerous other accidents interfered with the ascension of his balloon, but finally June 30 was officially given out as the date of the first trial. On that day thousands of people gathered on the shores of the lake, and the water was covered by a fleet that included craft of all kinds from the fisherman's primitive boat to the most modern private steam yachts and launches, all filled with would-be spectators of the event. They were doomed to disappointment, however, for the inflation of the airship was not completed and so, of course, no ascent could be made; nor was all ready on the second day, but toward night of that day the raft on which the airship rested was towed out on the lake a short distance. Even on the third day it seemed doubtful for some time whether any ascension could be made, but finally, just before eight o'clock, the raft and the balloon were again towed out of the house, the last rope was cut at three minutes after eight, the sliding weight was quickly regulated, and the airship began to move, trying to rise in a graceful curve, which, however, was interrupted at a height of about 150 feet by what seemed to be a rather strong current of air,



COUNT ZEPPELIN'S BALLOON ON ITS RAFT IN FRONT OF THE FLOATING HOUSE.



COUNT ZEPPELIN.

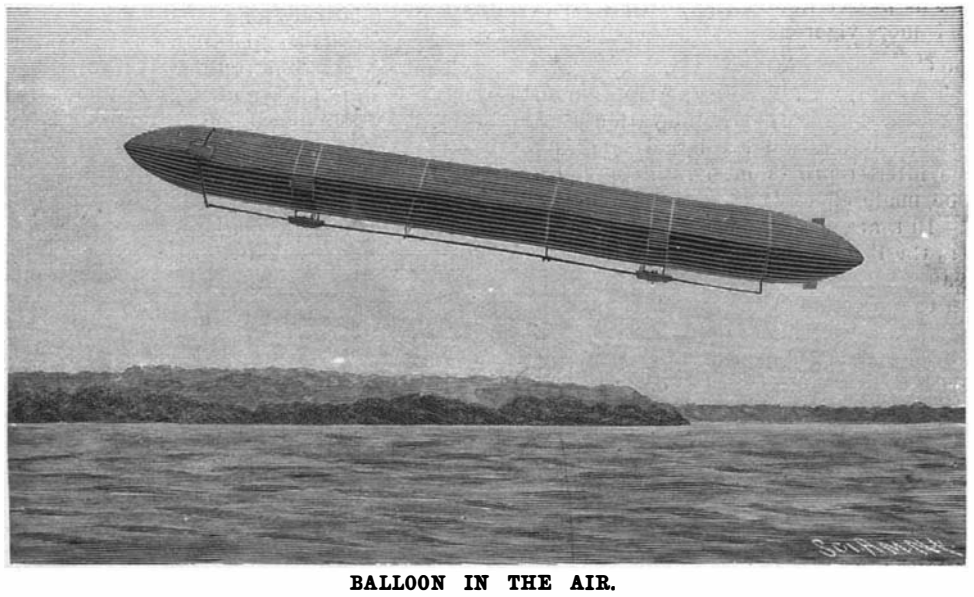
but it is said that the line connected with the sliding weight became entangled with a line from one of the side propellers. After that it was carried along with the wind in the direction of Immenstaad, where it descended to the water at 8.20, having attained a height of something over 1,300 feet and covered a distance of three and a half miles, traveling with the wind, at a speed of 26 feet per second. During this trial trip Count Zeppelin occupied the forward car with an amateur, Mr. von Bassus, of Munich, and an engineer, while in the rear car were the African explorer, Eugene Wolff, and a machinist.

Although all the hopes and expectations of the promoters and friends of the enterprise were not realized by the results obtained at the ascension of July 2, these results are interesting and important, and, as far as the ascent and descent are concerned, are entirely satisfactory; but it was evident that the amount of energy developed by the propellers was insufficient. Instead of the promised speed of 32 feet per second, a speed of only 26 feet per second was really obtained; moreover, in its present shape, the airship can scarcely be called dirigible. It is very certain that some decided changes will have to be made, and on the nature of these changes will depend its ultimate success; for if they concern only the motors, such alterations will probably be quickly made, but it is evident that radical changes must also be made in the steering apparatus. A steering device should be entirely removed from the domain of chance; if ropes are required for its manipulation they should be so arranged that there would be absolutely no danger of their becoming entangled with other ropes, or of their breaking. A steering device that will not obey the hand of the helmsman promptly and under all circumstances is worse than none. It should not be forgotten that changes in the machinery may involve an increase in the weight of the balloon itself, thereby causing a change in the static conditions, which have been considered the strongest point of this airship.

The Zeppelin airship belongs to the class of so-called aerostatic balloons or dirigible airships which hold a middle ground between the purely dynamic flying machines and the manually-operated devices, resembling in this respect what are known as "balloon flying machines"; that is, those airships in which hydrogen is used only for keeping the apparatus suspended, while mechanical power is employed for driving and steering it. The first notable trial of such an aerostatic balloon was made by Henry Giffard in 1855, and this was followed in 1872 by that of Dupuy de Lôme and Paul Hänlein, and in 1879 by that of Tissandier. All of these experiments were without important results, and the French captains, Renard and Krebs, were the first to bring an airship back to its starting point after a voyage of twenty minutes, having developed a speed of 19 feet per second. This record, which they obtained with the "La France," a balloon built by them, that made an ascension on August 9, 1884, has been equaled by no one since.

One thing it very certain, and that is that no airship of the Zeppelin type will ever carry many people, although it may be useful for military purposes and possibly for exploring expeditions that are not of too extended a character; but, on the other hand, the enormous expense incurred in the building of such an airship would be a serious obstacle in the way of its use. About $24,000 was invested in this undertaking, and it cost $2,380 to inflate the balloons for the ascension on July 2.

Much of the above data has been obtained from articles that have been published in l'Illustration and Ueber Land und Meer.



BALLOON IN THE AIR.

A Great Achievement.

The news that the steel viaduct across the Gokteik Gorge, in Burmah, will be completed well within the contract time, brings to the front another great achievement, illustrating American superiority in engineering works. The construction of this bridge was awarded the Pennsylvania Steel Company, of Steelton, for the reason that this plant was able to promise the completed work in one-half the time asked by the closest English competitor in the bids. The difficulties to be surmounted were uncommonly trying. Thirty-five skilled American mechanics were sent to Burmah for the important operations, and their dwellings, clothing, medical stores, machinery and material had also to be forwarded by steam and rail half around the world. Floods washed away much of the railroad between the gorge and Rangoon, the base of supplies. But the bridge will be finished on time. The structure is to be 2,300 feet in length, and the supports, all of structural iron, vary in height from 20 feet to 320 feet. The base of the highest towers covers 135 feet on each side. The scene is 150 miles from the nearest seaport, and all the material had to be transported, even to scaffolding, and the largest crane ever built, with an overhang of 164 feet and a lifting power of 25 tons in handling girders. The bridge will open a direct railroad line from Rangoon through to China. The company which ordered the big bridge is partly under the control of the British Government. Well informed engineers have stated that this work of American mechanical genius in India is one of the greatest feats of modern times, and of more importance, both as an engineering achievement and a victory for American ability, than the famed Atbara Bridge.—Bradstreets.

STEAM power is to be superseded by electricity in the Government dock yards at Kiel, Germany.

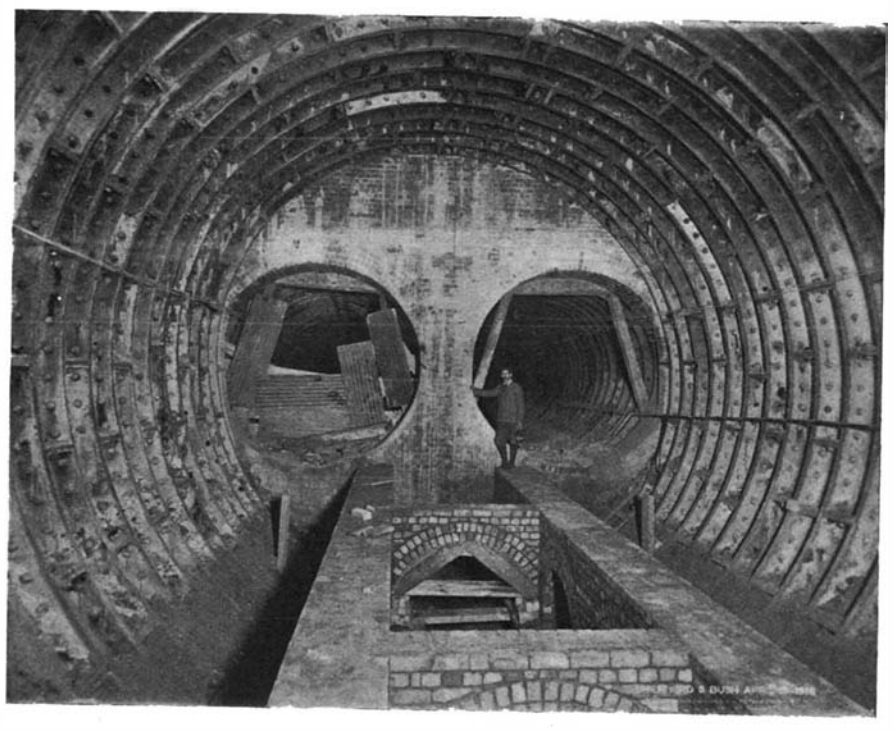
UNDERGROUND ELECTRIC RAILWAY, LONDON—METHODS OF CONSTRUCTION.

In our issue of July 28, 1900, we described the scope and equipment of the new electric underground railway, London; we now present a set of views showing the methods adopted in sinking the shafts and boring the tunnels. The railway consists of two circular tunnels, side by side, one carrying the up and the other the down trains. Taken on the whole, the task of driving the tunnels did not present any abnormal engineering difficulties, inasmuch as for almost the entire distance they were bored through the London clay, which extends to a very great depth. This is one reason why it is so much easier and cheaper to conduct subterranean operations in London than in New York; for, whereas the foundations of the former city are almost entirely clay, the latter city is built for the most part upon hard rock.

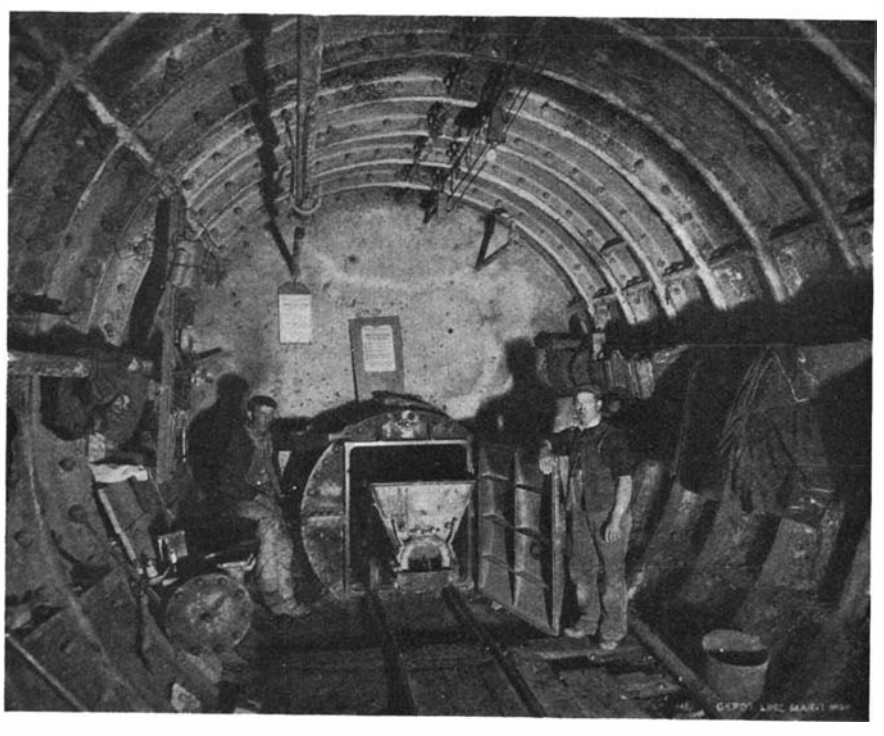
The contract for the construction and equipment of the whole system was given to the Electric Traction Company, of London, who sublet the work to various firms. The boring of the tunnels was undertaken by three firms, who each constructed a section. The first section, from the Bank terminus to the General Post Office, was built by Mr. George Talbot; the second section, from the General Post Office to the Marble Arch, by Messrs. Walter Scott & Co.; and the third section, from the Marble Arch to the terminus at Shepherd's Bush, by Messrs. John Price & Co. Perhaps the most expensive and difficult section to construct was the first. The city terminus is situated right in the center of the junction of the six busiest streets in London. It is flanked on one side by the Mansion House; on another by the Royal Exchange; and on the third by the Bank of England. The booking office is situated below the level of the street. This spot is the most impassable and dangerous for pedestrian traffic in the whole metropolis, and the city authorities exacted as a *quid pro quo*, for their permission to excavate, that the company should provide a circle of subways touching the ends of each street, so that foot passengers might effect a crossing from one thoroughfare to another without incurring any risk from the street vehicular traffic. This in itself was no light task. The majority of the London streets below the surface are thickly intersected with gas mains, sewers, pneumatic tubes, telephone wires, etc., and at this precise spot these barriers were extraordinarily intricate. With the exception of one large brick sewer, however, all the obstructions were successfully removed and diverted into a huge circular subway immediately below that provided for pedestrians. This innovation is peculiarly advantageous, since in the event of repairs, or the laying of new pipes, there is no necessity to disturb the surface of the roadway, as everything can be efficiently conducted in this tunnel. Then, in addition to these subways, five huge shafts and one wide stairway had to be sunk to give access to the platforms of the railway 68 feet below; while twenty feet lower still the City and South London Railway extends in a transverse direction. The whole of the street at this converging point is excavated below the roadway to a depth of 16 feet. The actual roadway itself, which is only 18 inches in thickness, entirely rests upon the troughed steel roofing of the booking office, though, of course, the necessary supports are more than adequate to resist the pressure that is at all likely to be brought to bear upon them. The whole of this excavation was performed without having to break the roadway in one single instance, and the traffic was only partially interrupted during the time the actual steel roof was being put in.

The five shafts for the electric elevators at the Bank terminus contain some of the widest elevators on the whole system, being each 20 feet in width. The process of constructing

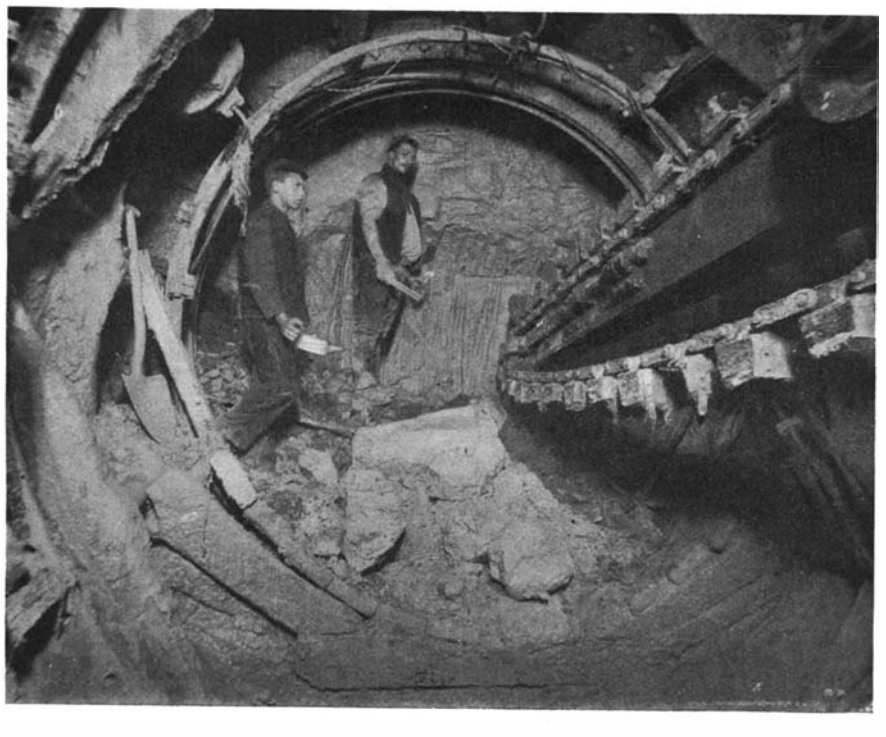
Sinking a Caisson, Preparatory to Excavating the Tunnel.



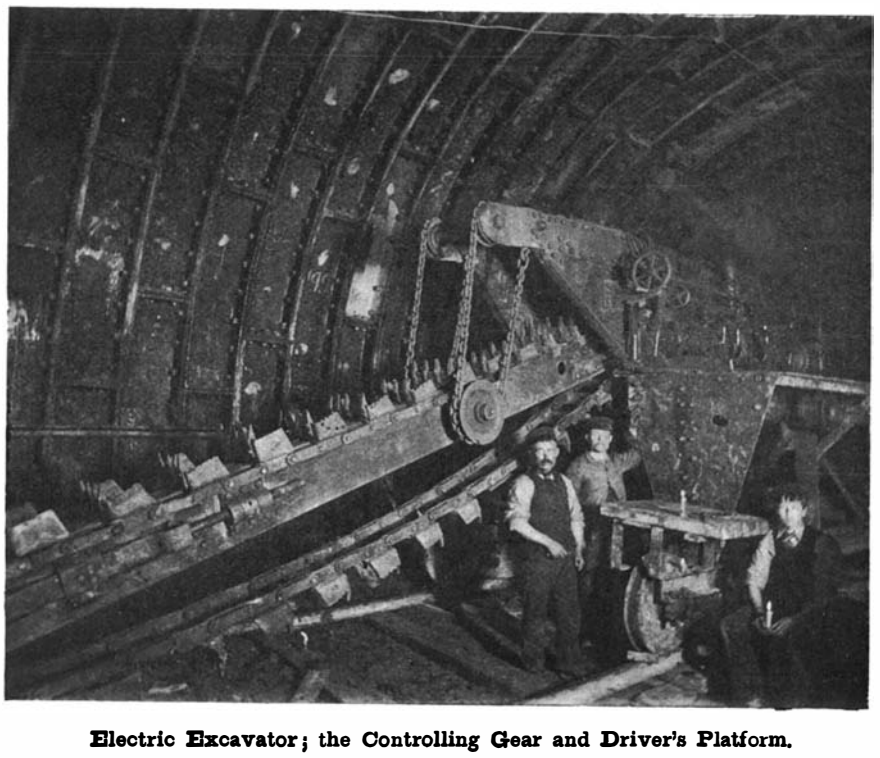
Shepherd's Bush Station Tunnel, 21 Feet Diameter, Showing the Two 11-Foot Tunnels for the Tracks.



Interior of the Compressed Air Chamber.



Electric Excavator, Showing the Buckets Working on the Face of the Clay Within the Shield.



Electric Excavator; the Controlling Gear and Driver's Platform.

UNDERGROUND ELECTRIC RAILWAY, LONDON—METHODS OF CONSTRUCTION.

these shafts was as follows: The friable soil was primarily removed, and the first ring of plates sunk and bolted in position. The clay inside the shaft was then excavated and the ring of plates underpinned until a sufficient depth had been attained to permit of a second ring of plates being bolted to those of the first. The digging was then continued, and the same processes of underpinning and bolting together of plates repeated until the shaft had been sunk to the desired depth. In reality, therefore, the iron shell of the shaft was constructed in a downward direction, ring by ring, from the top. By this means elaborated shoring up of the earth was rendered unnecessary, since the shaft was completed as work progressed.

When the bottom of the shaft was gained preparations were made to construct the tunnel itself. A sufficient quantity of earth was removed to admit the Greathead shield being placed in position. Two shields were employed in the work. The smaller one, which measured 11 feet 6 inches in diameter, was employed for the boring of the permanent way tunnels, and the other, which was 21 feet 2 inches in diameter, served to excavate the earth for the stations.

The process of boring was, briefly, as follows: The shield was forced slowly forward under the powerful application of hydraulic rams. The clay in the interior of the shield was then removed by laborers, and conveyed to the foot of the upward shaft in trucks hauled by horses or electric motors. When the clay had been removed, a ring of tunnel-plates was erected in the rear end of the shield and securely bolted up. The rams were once more brought into action and the same process repeated. The hydraulic rams, twenty-two of which were employed to drive the big shields into the earth, consisted of cylinder and case and crosshead. One end of the ram rested against the front flange of the last inserted ring of plates, while the head rested upon a similar flange on the rear end of the shield. When the power was applied, the shield was gradually pushed forward to the full extent of the stroke of the ram, which was equal to the width of the tunnel plates. The rams were so adjusted that they could be either employed in unison or individually, so that pressure could be directed upon any desired portion of the shield. In the case of the small shields compressed air engines were utilized for pumping the pressure water for the rams. With an exerted pressure of 50 pounds per square inch of compressed air a pressure of 2,240 tons was imparted by the water to the rams. In the case of the larger shields electric motors supplanted the compressed air engines. The tunnel plates being fixed inside the shield, when the latter was forced forward, a small annular space was left between the outside of the tunnel plates and the earth. This was filled up with grouting forced through holes purposely bored through the tunnel plates by means of compressed air. The rate of progress in the actual tunneling varied from 40 inches to 80 inches per working day of 10 hours; but on the average 1,000 tons of clay were excavated in that time. The removed clay was hauled to the surface, dumped into barges and carried down the river to Barking, where it was deposited in connection with some reclamation scheme.

At one or two points throughout the route the engineers were confronted with slight difficulties. Some of the streets under which they passed were so narrow that they would not admit of the tunnels stretching side by side without encroaching upon private property. This had to be avoided, so the tunnels and stations were constructed one above the other. Then again, at Holborn, where the line crosses the old Fleet River, and where the configuration of the ground brings the railway nearer the surface, and there was the additional weight of the viaduct and surrounding lofty buildings to carefully consider, compressed air was employed as a safeguard against any possibility of the earth collapsing; in this case work was continued in a chamber wherein the atmospheric pressure was increased to resist the pressure upon the shield. The increased atmospheric pressure was not very excessive, being only 35 pounds to the square inch against 15 pounds per square inch normal, but the total pressure in the interior of the lock upon the entire working face was about 150 tons.

Messrs. Walter Scott & Co. in their section experimented with an electric excavator, constructed after their own designs for the removal of the clay. This was the first occasion upon which such a contrivance, driven by electricity, had been employed for this purpose. So far no mechanical device has been placed upon the market that will successfully excavate the earth in limited confines, such as these small tunnels, and deliver it directly into the ballast wagons. This machine in design was not unlike a dredger—indeed, its principle was exactly the same. It consists of a carriage slung on wheels, traveling on rails set to a gage of 6 feet 3 inches. The superstructure of the excavator was raised to a sufficient height to permit the ballast wagons to run underneath it. The excavating was accomplished by means of dredging buckets passing over a long horizontal ladder, and scraping the face of the earth in their passage. There were 37 buckets in all traveling over a ladder 37 feet in length. The buckets were not buckets correctly speaking, since they consisted of only a bottom and a back. Into the back were securely fixed a number of wrought iron chisel-pointed teeth, for biting the earth, which after its removal was carried along in the bucket and emptied into the trucks underneath. The buckets, in the first instance, were made of cast-iron; but as one or two of them were broken through coming into contact with hard substances in the face of the earth, they were replaced by others made of gun metal.

The electric motor for generating the necessary power for working the digger was placed upon the platform of the carriage. To operate, the machine was driven up to the face of the earth and set in motion. The chain of buckets revolved rapidly, and as they passed over the nose of the ladder, pointed toward the earth, they removed a small quota of ballast with their sharp teeth. By means of levers it could be slewed round in any direction so as to excavate to the whole of the desired surface of the earth within the shield, with the exception of the extreme top and sides which it could not reach. When a sufficient quantity of earth had been removed, the machine was run back for about 12 feet, and the shield driven forward by the hydraulic rams. The cutting edge of the latter, as it was forced forward, brought down that clay which was not removed by the buckets of the excavator. To guard against any damage being inflicted upon the machine by contact with any impediments in the earth upon which it was in operation a fuse was placed in the lead of the motor. A reversing switch was provided in order that the motion of the bucket ladder might be reversed if necessary or withdrawn. The driver controlled the machine from a small platform placed upon the carriage. The utilization of this excavator was purely an experiment, and although it worked satisfactorily its services were not continued. It was economical so far as regards manual labor, since with six men in attendance it could do the work of fourteen laborers.

Particulars of the Six 22-knot Armored Cruiser for Our Navy.

The Secretary of the Navy has asked for bids for the construction of six armored cruisers authorized by the acts of March 3, 1899, and June 7, 1900, the cost of which will aggregate $24,750,000. The three vessels authorized by the first act are to be sheathed, and the other three unsheathed. The unsheathed vessels are to be of not less than 13,400 tons and the sheathed vessels of 13,800 tons displacement. No bids will be considered that do not conform to the above figures, and they must guarantee a speed of not less than 22 knots and a bunker capacity of not less than 2,000 tons. The maximum time allowed for completion is thirty-six months for each vessel, and there will be penalty of $300 per day for the first month, and $600 per day for each subsequent day, after the time for delivery has passed. No vessel will be accepted that falls below 20 knots in speed and there will be a reduced compensation of $50,000 for each quarter knot down to 21½ knots, and of $100,000 for each quarter knot below 21½ knots. The main battery will consist of four 8-inch breech-loading rifles, and fourteen 5 inch rapid-fire rifles. The secondary battery will consist of eighteen 3-inch rapid-fire guns, four 1-pounders, four 1-pound or single-shot guns, and ten smaller rapid-fire and machine guns. The limit of cost for the first three ships is $4,000,000 and for the three ships authorized in this year's Naval bill is $4,250,000.

Selenides of Iron.

M. Fonzes-Diacon has recently presented to the Académie des Sciences an account of his experiments in the formation of the selenides of iron. As regards the previous experiments in this direction, Little has obtained a selenide of iron corresponding to the formulas $Fe_2\ Se_3$ by the action of selenium vapor upon iron heated to redness; the product thus obtained, melted under a layer of borax with an excess of selenium, gives the selenide of iron. M. Fabre has obtained a ferrous selenide of crystalline structure by heating, with iron filings, the product obtained by the action of selenium vapor upon pure iron wire. The experimenter has succeeded in forming the different selenides of iron, corresponding to the sulphides; these have the formulæ $Fe\ Se_2$, $Fe_2\ Se_3$, $Fe_3\ Se_4$, $Fe_7\ Se_8$, and $Fe\ Se$.

The ferrous selenide is produced by the reaction of selenium vapor or hydrogen selenide upon iron at a red heat; the product has no appearance of crystallization. The ferric selenide is obtained by the action of hydrogen selenide upon ferric oxide, $Fe_2\ O_3$, at a low red heat, the oxide being transformed into ferric selenide, $Fe_2\ Se_3$. The sesquiselenide thus formed has the appearance of a gray crystalline powder with bluish reflexions; a microscopic examination fails to show any clearly defined forms. In another experiment, anhydrous perchloride of iron, or peroxide of iron, heated in a porcelain tube at white heat, are transformed, in a current of hydrogen selenide, to gray selenides, agglomerated in masses presenting violet or bluish tints. According as the temperature is more or less elevated, compounds are obtained corresponding to the formulæ $Fe_3\ Se_4$ or $Fe_7\ Se_8$. Some of the samples have a crystalline structure and appear to belong to the cubic system, but the forms are indistinct. The biselenide of iron, containing the greatest proportion of selenium, is prepared by reacting upon anhydrous perchloride of iron, heated below redness, with hydrogen selenide drawn through by a current of nitrogen. The perchloride, volatilized in part, collects in scales upon the cooler parts of the tube in which the operation is made; they are slowly transformed to selenide of iron, while still preserving the same pearly appearance. A corresponding phenomenon has been previously observed by M. Moissan in the preparation of sulphide of chromium. Analysis shows that this selenide corresponds to the formula $Fe\ Se_2$, making it a biselenide of iron. When heated in a current of oxygen it is transformed to red oxide of iron with disengagement of $Se\ O_2$. As to the general properties of the selenides of iron, they are attacked by concentrated or gaseous hydrochloric acid in greater or less degree, according to the proportion of iron; the $Fe\ Se_2$ containing the largest proportion of selenium is not attacked. Nitric acid transforms the selenides to selenites. Chlorine displaces the selenium without difficulty. When heated in a current of oxygen, they leave a residue of red oxide of iron, with sublimation of selenious anhydride. Hydrogen, at high temperatures, reduces them to ferrous selenide.

The New York Zoological Park.

It is less than two years since the Zoological Society assumed control of this park and began their first building. Simultaneously with the erection of dens, aviaries and other animal buildings, and the installation of the animals by the society, the city has been constructing miles of walks, roads, and sewers, has been trimming trees, deepening ponds, etc. Although only one-third of the proposed work is completed, the present condition reflects great credit upon the officers of the society and the generous founders and patrons whose gifts have made possible what has been accomplished.

Besides the 227 acres of partly-wooded, somewhat rocky upland and lowland, there are Bronx Lake of 25 acres, Lake Agassiz of 5½ acres, and the Aquatic Mammals Pond, Cope Lake and Beaver Pond; the last three include together, 3½ acres.

The Park is strewn with glacial bowlders of granite or trap rock; of these the largest is what is known as the Rocking Stone. This the visitor should not miss. It is a mass of quartzite granite, 7½ feet high, weighs about 30 tons and is so nicely poised on an angle that a pressure of 50 pounds will cause the apex to swing north and south about 2 inches. The stone is easily found, as it lies on a high point overlooking the Buffalo Range, not far from the West Farms entrance.

The animals are provided with ranges or houses of ample proportions. The buffalo and deer of various kinds have quite extensive grazing ground.

The Reptile House and the Bears' Dens about equally divide the children's attention at present, though the sea lions are a close second to either of these attractions. A great deal of interesting information about snakes of many kinds can be gained in the Reptile House, where each species has its own home with appropriate surroundings. Close by them he will see an anaconda climbing in a tree, and the graceful axolotl from Mexico swimming in its tank. If he stays long enough he will be able to watch the metamorphosis of the tadpole to the frog. If he is there at the right time he will see the alligators fed with whole fish, each one of the seven taking his turn like so many children, and some of them getting an affectionate pat from the keeper as they snap their huge jaws together.

The Prairie-dogs' Village is a comfortable looking place, where fifty marmots burrow and howl as they please, happy as they could have been in their native Montana home.

The Beaver Pond will, in time, be one of the chief points of interest, for all the materials for dam building are here, and they are to be so left that the cunning craftsmen can work under the only conditions they will accept—slight observation.

All these creatures and hundreds of others already installed, or soon to be, are on view every day in the week.

A CAP NUT lock for propellers has been invented by Capt. Lewis Davis, of Liverpool, and is intended to prevent the loss of blades at sea, says The Engineer. The center of the cap nut and the center of the fixed stud or bolt are bored, and a left-handed flat-head bolt is inserted. Through the head of this bolt and on the cap-nut are a number of holes, so arranged that locking pins can be inserted. A flat cap piece is also screwed into a recess made on the head of the bolt, and again through the center of this is screwed a small-headed screw. The worming of each bolt or nut is contrary to that preceding, so as to check any loosening tendency. A rubber washer is placed under the flat cap to prevent the entry of water.

THE PETRIFIED FOREST OF ARIZONA.

BY D. ALLEN WILLEY.

In the northwestern part of Apache County, Arizona, is located the most remarkable petrified forest yet discovered on the American continent, and what geologists believe to be the most wonderful specimens of silicified trees in the world. The forest is about 8 miles square and was originally composed principally of firs. It is located upon a plateau which is 5,500 feet above tide water, although the theory of geologists is that the woodland in its natural state originally existed at a much higher altitude. It is in the center of one of the most desolate parts of the West, surrounded for many miles by a country which yields principally sage brush and soapweed. The nearest stream, which is about 20 miles distant from the forest, is lined with a stunted growth of cottonwood trees and is called the Dirty River from the quality of the liquid, which can hardly be called water, flowing through it. The cottonwood trees and a small clearing at the nearest railroad station include the only living vegetation in the vicinity of the forest, with the exception of a few small cedar trees and bushes near what is termed the "Natural Bridge."

The plateau on which the forest exists is divided into many small gorges and gulches, and the strata of which it is composed consists principally of beds of clay, sandstone and sandstone shale. Under a portion of the strata water can be found at a depth of but a few feet, and it is believed that below it are several subterranean water courses. The trees in various forms are scattered throughout the region, the majority consisting of fragments of trunks, although quite a number are in a vertical position. The great majority are completely petrified, as far as the wood is concerned, and have an outer coating of what seems to have once been sand and gravel. This coating, it is believed, was formed by the action of the elements and by the movement of the trees at different periods in the world's history. Geologists have divided the forest into what are termed three centers of accumulation, on the theory that much of the wood has been carried from one point to another by natural phenomena. In each of these centers of accumulation can be found logs and blocks from a few inches in diameter to 5 feet, while trunks in length range up to 50 feet, although the tree forming the Natural Bridge has been measured a distance of 111 feet to a point where it meets the sandstone formation. Its length in the formation has not, as yet, been estimated.

Throughout the forests are scattered mesas upon which are many of the larger fragments. They are of brilliant tints in red, yellow, blue, and combinations of these colors, and sections cut through the center show that the interior of the logs have completely changed into the forms of agate, jasper and chalcedony. Judging from portions of the larger pieces which have been found, some of the original trees must have been from 150 to 200 feet in length. Owing to the fact that quartz crystals are abundant in the forest, many of the best specimens have been cut, also blown up with explosives by persons who wish to get solid crystals, which are generally found near the center of the tree. There is every evidence that a century or more ago the Indians in this part of the United States, and possibly prehistoric inhabitants, visited the forest to obtain material for hatchets, arrow heads and knives, as the same material has been found in such implements among the cliff dwellers of Arizona and the Southwest.

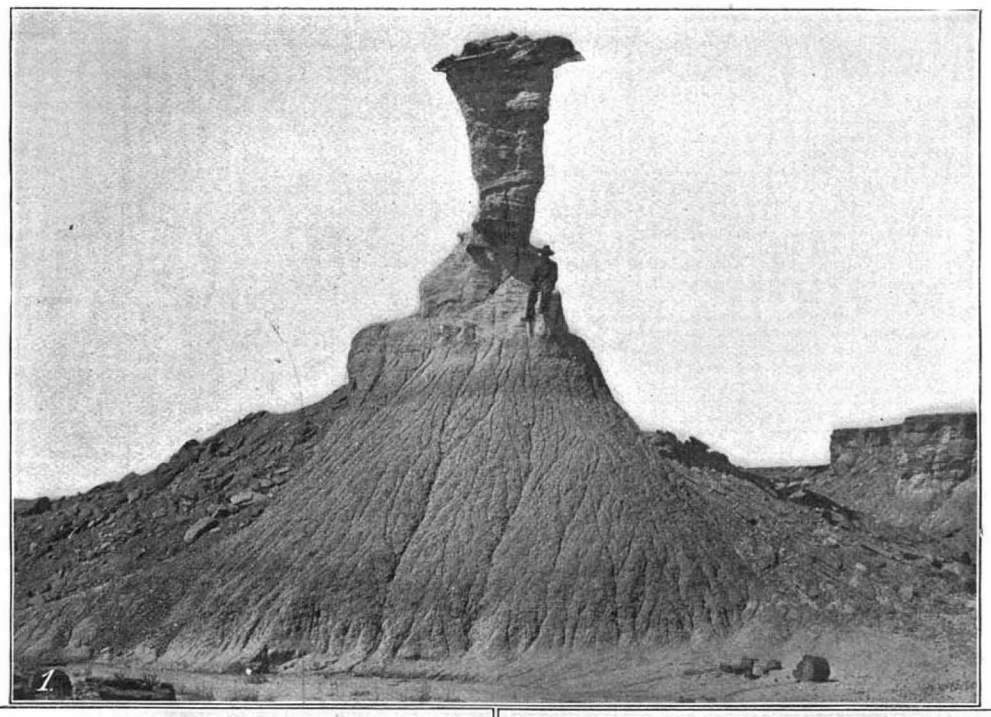
The beauty of the silicified wood and its hardness has attracted attention to the petrified forest by manufacturers, who have used it as a substitute for onyx and other material for the manufacture of table tops, clock cases, tiling for floors, and even curious jewelry. At the Chicago Exposition an assortment of articles manufactured in material obtained in the Arizona forest was shown, which attracted much attention. Another collection is now on exhibition in Paris. The material also forms an excellent substitute for emery for milling purposes, and several years ago a company was organized which located a mill for reducing it to a powder on the edge of the forest. Owing to competition from Canadian manufacturers, this plant was never placed in operation, and consequently a large portion of the forest was saved from destruction.

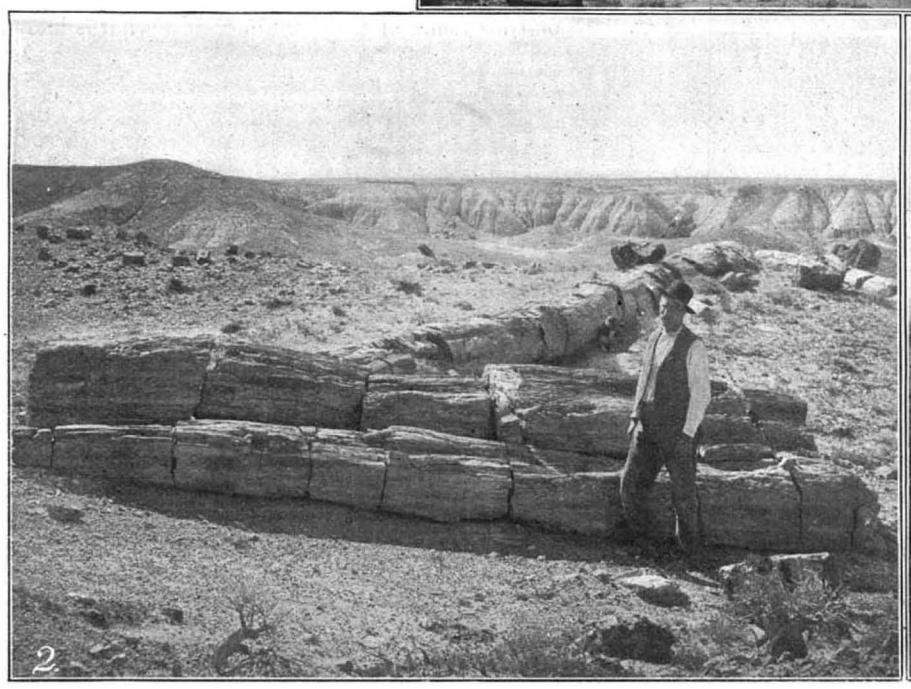
The position of the various trees in the forest makes it exceedingly picturesque, but since 1853, when it was first discovered, but comparatively few tourists have explored it, owing to the difficulty in crossing the gorges and in climbing the mesas and other forms. Some of the trees have been found projecting from deposits of what were evidently at one time volcanic lava and ashes, as high as 25 feet above the volcanic foundation. Others are on the edges of the gulleys lying like gigantic cannon, as if protecting the locality from the intruder. In some portions of the forest trunks are piled as neatly as if they had been arranged for the sawmill, ten to fifteen being counted in one lot. As will be noted by the accompanying illustrations, a large number of them are in lengths of but a few feet and at a distance looked like great cart wheels. As their centers are beautifully tinted with the colors referred to, the scene in the sunlight is so brilliantly dazzling that the visitor could imagine himself in a sort of earthly paradise were it not for the desolate surroundings formed by the clay, sandstone, and volcanic formations.

Probably the most remarkable feature of the forest is the Natural Bridge already referred to. This forms a thoroughfare across one of the gulleys or canyons upon which a man can safely travel and which has been crossed by a sure-footed mule. The bridge consists merely of a huge tree trunk, which, it is believed, has never moved from the original section in which it fell. The center of the trunk shows that it is completely silicified. The exterior is coated with a sort of cement made of sand-rock, in which geologists believe it was originally imbedded. At the middle it measures 10 feet in circumference and at the base 4 feet in diameter. No branches, however, of any kind can be found upon it, nor are there any indications that branches have ever grown from the trunk. The supposition is that the gulley has been formed by the action of the elements washing away the formation from beneath the trunk as it lay where it originally fell and that its first bed was upon solid ground.

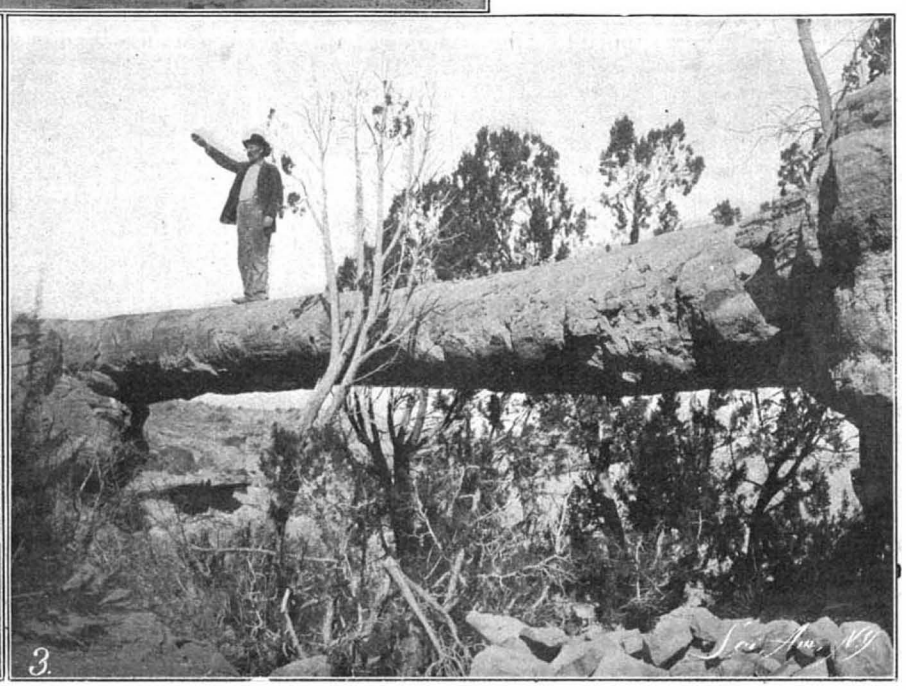
Several theories of the petrifaction of these trees have been advanced. One is that ages ago a volcanic shower buried a number of forests in the Southwest and that the action of water in later periods produced the necessary chemical action to change the woody matter into the present material. In the case of the Arizona forest, however, there is little evidence of volcanic action, except in one or two portions. Many of the trees are found in the sandstone formation, and this has caused much discussion among geologists. It is admitted that the trunks and other fragments must have become petrified in the locality where they were found, as their weight would render it impossible for them to have become moved to the place by floods or by any convulsion of nature, owing to their size and the form in which they have been discovered.

At the last session of Congress the question of preserving the petrified forest in its present condition was brought up by a memorial from the Arizona Legislature that it be made into a national park like the Yellowstone. The Government has had examinations made of the tract, and it is probable that some action will be taken at the next session.





The Twin Sisters.



Eagle Rock Monument.

An Agatized Log Bridge.

THE PETRIFIED FOREST OF ARIZONA.

A Prize for Insulating Gloves.

A competition for insulating gloves to protect electricians is being held by the Association des Industriels de France Coutre les Accidents du Travail, 3 Rue de Lutèce, Paris. A prize of 1,000 francs will be given for the best glove. Two pairs must be sent before December 1, 1900. The gloves must afford sufficient protection to the hand and forearm and must not only resist the current, but also any accidental perforation. Free play must be allowed to the fingers and the gloves must be easy to put on.

GREAT BRITAIN'S contribution to the immense photograph of the heavens, which is being prepared by all the leading observatories throughout the world, is making rapid progress at Greenwich Observatory, according to the report of the Astronomer Royal. The catalogue of star places resulting from this observation is also being printed.

RECENT EXPERIMENTS WITH THE RADIATIONS OF POLONIUM AND RADIUM.

The discovery of M. Becquerel, that the radiation given off by certain bodies called radio-active could be deflected by the action of a magnetic field, has brought out a number of new observations in connection with these phenomena. The radiations given off by substances containing the newly discovered elements, radium and polonium, although having the same effect upon a photographic plate or fluorescent screen, are shown to be of a different character.

Thus M. Becquerel, in his previous experiments, found that while the radiations of radium could be deflected by a magnetic field, those of polonium are not so deflected. M. and Mme. Curie, to whom is due the discovery of these two new elements, have brought before the Académie des Sciences a series of experiments which show the difference between the forms of radiation given off by the two elements. In the first series of experiments made by M. Curie with the element radium, advantage was taken of the fact that, when made to pass between the two plates of a condenser, these rays cause a certain current to pass from one to the other, and by measuring this current the intensity of the radiation may be estimated. The experiment was made in the following manner.

At *A*, Fig. 1, is placed the body containing radium, whose radiations pass between the condenser plates, *PP'*; it is surrounded on three sides by the masses of lead, *BB*. A magnetic field, represented by the area, *EE*, may be caused to pass in a direction perpendicular to the plane of the diagram. The condenser plate, *P*, is charged to 500 volts, and the plate, *P'*, is connected to an electrometer and to a sensitive current-measuring instrument. The region traversed by the rays is surrounded by the masses of lead and by the extremities of the pole pieces. When the distance to the condenser, *AD*, is over 7 centimeters, it is found that upon exciting the magnet none of the rays strike the condenser, these being deflected and absorbed by the masses of lead. If *AD* is less than 6½ centimeters, it is found that only a part of the rays are deflected by the field. The proportion of non-deflected rays is found to be greater as *AD* is smaller, and for very small distances the proportion is only a small fraction of the total. The table shows the quantitative results obtained. The upper line gives the distances, *AD*, and the lower, the percentage of non-deflected rays, supposing 100 to be the current which passes in the condenser when the field is not excited.

Distance, *AD*, centimeters.	7·1	6·9	6·5	6·0	5·1	3·4
Percentage of non-deflected rays	0	0	11	32	56	74

It thus appears that the radium gives off two kinds of radiation, one of which may be deflected by the field, while the other is unaffected. It is found that the rays present other differences in character; thus, the deflected rays possess a greater penetrating power than the others. When a screen of aluminium or black paper is placed before *A*, the deviable rays only are allowed to pass, and thus by exciting the field the whole of the radiation may be suppressed. A sheet of aluminium of $\frac{1}{100}$ millimeter is sufficient to cut off all the non-deviable rays from the condenser when it is at a sufficient distance; when it is brought within 5 centimeters, two sheets are necessary. A number of experiments were made with different substances containing radium, with analogous results. A remarkable phenomenon is observed in all these cases, namely, that the non-deviable rays do not pass in air beyond a certain distance from the source, this being about 67 millimeters. It was also observed that the proportion of the deviable and penetrating rays was only a small percentage of the whole.

The compounds of polonium experimented upon give only the non-deviable rays, as M. Becquerel has already found. When the distance, *AD*, is varied, no action upon the condenser is observed until it is brought to within a certain distance (40 millimeters for the sample in question); the radiation then suddenly reveals its presence by a marked action upon the condenser, and this increases regularly as it is approached, the magnetic field having no effect. It seems that the rays of polonium are thus limited in space and surround the active matter in a kind of layer. In this respect there is a marked resemblance to the non-deflected rays of radium, both possessing little penetrating power and being limited in their action by the distance.

A series of experiments has been carried out by Mme. Curie to show the differences in the two forms of radiation given off by radium. The non-deviable rays have much less penetrating power than the others, and a study of their comparative penetration shows that their nature is entirely different, thus confirming the results obtained with the magnetic field. In the previous experiments made with the rays of radium, their action was found to resemble that of the X-rays. They have greater penetrating power according as they have traversed a greater thickness of matter, and this has been attributed to the presence of rays whose penetrating power was unequal. It is found that while for the deviable rays the co-efficient of absorption decreases or is perhaps constant as the thickness of matter is increased, on the contrary the non-deviable rays are more easily absorbed according to this thickness. This singular law of absorption is contrary to those which are known for all other forms of radiation; it gives the idea of a projectile which loses a part of its vis viva in traversing an obstacle. The experiments were carried out as follows: *PP* are a pair of condenser plates arranged and connected as before. They are surrounded by the metallic box, *B B*, connected to earth. The active matter, *A*, is placed in a metallic box, *C*, back of the plate; the rays may then act upon the condenser through the metallic screen, *T*, the distance, *A T*, being variable. By putting different screens upon the polonium compound at *A*, the absorption is noted. The results obtained are as follows: For certain values of *A T*, above 4 centimeters, no current passes; thus, the rays do not penetrate into the condenser. As this distance is diminished, the appearance of the rays in the condenser is somewhat sudden, so that for a small variation in distance one passes from a small to a large current. This action then increases regularly as *A* approaches *T*. When *A* is covered by a sheet of aluminium $\frac{1}{100}$ millimeter thick, a greater absorption is produced as *A T* is greater. If a second sheet is placed upon the first, each absorbs a certain fraction of the rays, and this absorption is greater for the second sheet than for the first.*

Distance *A T*	3·5	2·5	1·9	1·45	0·5 centimeter.
Percentage of rays transmitted by one sheet	0	0	5	10	25 per cent.
Percentage of rays transmitted by two sheets	0	0	0	0	0·7 per cent.

It is seen that the radiation is diminished in greater proportion in the farther than in the nearer regions.

The experiment was then made with the non-deviable rays of radium, the others being suppressed by a magnetic field. The rays which travel farthest in air are the most absorbed by the aluminium, as will be seen in the table.

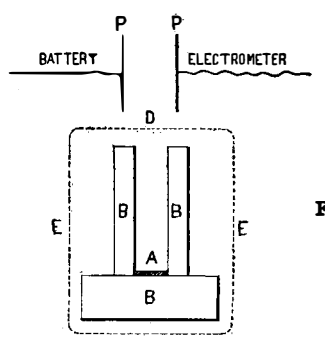


Fig. 1.

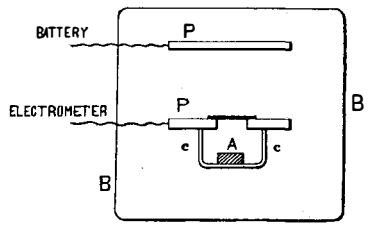


Fig. 2.

Distance *A T*	6·0	5·1	3·4 centimeter.
Percentage of rays transmitted by the screen	3	7	24 per cent.

There is thus a striking analogy between these corresponding radiations of radium and polonium. In view of the special properties of the non-deviable rays the question arises as to whether they are rays of rectilinear propagation. M. Becquerel has made an experiment which shows the affirmative. The compound of polonium is placed in a narrow linear cavity made in a piece of cardboard, thus giving a linear source of radiation. In front of this was placed a copper wire, 1½ millimeters in diameter, at 5 millimeters distance, and a photographic plate at 9 millimeters from the wire. After ten minutes' exposure the geometrical shadow of the wire was produced, of the expected dimensions, with a very narrow penumbra corresponding to the width of the source. The same effect was observed when a double sheet of aluminium was placed before the wire, which allowed the rays to traverse it. It is thus shown that the new form of radiation is propagated in straight lines, and is not diffused in passing through the screen.

* A series of quantitative measurements are shown in the table. The distance, *P P*, equals 3 centimeters.

An Ancient Stone City Discovered in New Mexico.

In excavating a number of large stone ruins in New Mexico, between Bland and Espanola, some remarkable discoveries were recently made by Messrs. George S. Cote, F. C. Cote, R. W. Bullock and G. S. Madden. The building discovered measured 560 by 400 feet. It was two or three stories high originally, but the walls are only from 6 to 10 feet high at the present time. It is probable that the upper story was opened to the sky, and upon this the dwellers spent both night and day. A remarkable find was made in a room which measured 9 by 12 feet. An old furnace for smelting iron was found, near which was a large iron bar deeply incrusted with rust; also pieces of copper ore, gold ornaments, and a piece of turquoise. Twenty-five beautiful pieces of pottery were also found in the room. They were decorated. One of the designs represented the picture of a building with a smokestack and smoke curling out of it. Around the fireplace in the room which was excavated stood a dozen large pots, each with bones in it, showing that when the inhabitants abandoned the room they were preparing a meal. Baskets, iron knives, stone battle axes, musical instruments and other objects were also found. There are also estimated to be from 1,200 to 1,500 rooms in the building, only one of which has been excavated. There are said to be hundreds of similar ruins in the twenty-five miles from Bland to Espanola. This would seem to indicate that at some time more people lived in New Mexico than reside there to-day. Rev. Mr. Madden's theory, says The New York Times, is that about five or six hundred years ago the dwellers in that region were driven out either by an earthquake or by an invasion of a stronger race. The relics were sent to the Northwestern University at Evanston, Ill.

Photographic Paper.

M. Van Loo, a Belgian photographer, gives a method of preparing a photographic paper somewhat resembling platinotype, but much less expensive. The paper is coated with the following solution:

Water	1,000 parts.
Ferric oxalate	15 "
Oxalic acid	3 "
Nitrate silver	3 "

The above proportions should be adhered to as nearly as possible to secure good results. The printing is carried out in the same manner as with platinum paper; that is, until the image is well distinguished. After printing, the paper is placed in a developing bath made up as follows:

Water	1,000 parts.
Borax	60 "
Tartrate soda	60 "

Dissolve, and add several drops of a 5 per cent solution of potassium bichromate; a greater proportion of bichromate gives an image hard and full of contrast; by using less, the image becomes gray and feeble. A certain latitude is thus given, which is of advantage for negatives of different intensities. After the development, which lasts five or six minutes, the prints are washed for a few moments in running water and the toning is carried out with the following bath:

Water	1,000 parts.
Potassium chloroplatinite	1 "
Common salt	10 "
Citric acid	10 "

The prints are left in the bath until the desired intensity is obtained, and are then fixed in a 2 per cent solution of ammonia; the fixing lasts about 10 minutes. They are then washed thoroughly, as usual.

The Building Edition for August.

The Scientific American Building Edition for August is a beautiful issue of this notable periodical. It has the usual colored cover and the first page is occupied by a view of the Pavilion of Belgium at the Paris Exposition. "Belcourt," the residence of O. H. P. Belmont, at Newport, is the subject of three pages of engravings. "Some Picturesque Bits of Unknown Italy" illustrates three attractive features of that country. There are a number of cottages and residences of various prices scattered through the number. "Prismatic Lighting for the Illumination of Dark Interiors" is by Dr. William H. Green, and is accompanied by several illustrations.

The Current Supplement.

The current Supplement No. 1284 has many articles of unusual interest, the chief of which is "Sanitary Equipment and Power Plant for Modern Lodging Houses." This is a specially prepared article for the Scientific American Supplement, and gives an elaborate description of all the interesting engineering and sanitary features of Mills Hotels Nos. 1 and No. 2, the best planned and equipped workmen's hotels in the world. "Iron and Steel Rails in America" is by Robert H. Hunt. "Egyptian Temples" is by Alexander Payne. "Legislation for the Protection of Birds Other than Game Birds" is a profusely illustrated article. "The Development of Agricultural Libraries" is also of much interest.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

CULTIVATOR.—THOMAS OLDHAN, Leipsic, Indiana. In this invention devices are combined for plowing, harrowing, dragging and rolling the soil, the devices being so constructed that by certain rearranging and adjusting of the parts the implement may be adapted for all the various phases of cultivating. The implement is supported at the front by a small wheel, and at the rear by a land roller, and is guided by moving the roller to the right or left. A novel arrangement of cultivator frame, drag and adjusting device, is provided, whereby to raise and lower the cultivator frame and drag.

The same inventor has patented a double cultivator embodying the same principles as that referred to above. In the double cultivator for cultivating two or more rows of plants, the two land rollers are mounted in a manner to be simultaneously turned to the right or left and means are provided for simultaneously raising or lowering the several cultivator frames, drags and their appurtenances.

DEVICES FOR GATHERING PRUNES.—OLIVER S. HOOVER, of Stanford University, and MORRIS T. HOOVER, Mount View, California. These inventors have produced an apparatus, constructed on radically new lines, for gathering from the ground the prunes which have fallen from the tree. A series of gathering tubes are provided, which are pneumatically controlled in their movements, and a suction is produced to gather up the prunes. The gathering tubes adjust themselves to the irregularities of the ground and the apparatus is rendered automatic in its several operations of gathering, handling and depositing the prunes in a receptacle.

COMBINED HAY AND STOCK RACK.—THOMAS A. RAPSON and HERBERT J. FURNESS, Filion, Mich. As indicated by the title, this invention consists of a rack which may be adjusted to a wagon body either to constitute a stock rack, by so arranging it as to form vertical extensions of the wagon body, or folded outward to constitute a hay rack. The novelty lies in the new arrangement of braces and connecting members to strengthen the rack and permit of its quick adjustment to the different positions.

Steam, Gas and Water.

PISTON VALVE.—WILLIAM BUCKLEY, Sheffield, England. Having in mind the danger of excessive compression taking place in the cylinder with the risk of bursting the cylinder or breaking of valve rings, the present invention provides in the piston valves themselves a means of relieving any undue pressure as may occur, for instance, when the engine is reversed and the steam ports closed after the cylinder has received a charge of steam. The object is effected by means comprising valve bodies having a novel arrangement of openings and steam passages, in connection with which passages spring-pressed relief valves are provided, the arrangement being such that the relief valves open only when the pressure on their faces from within the cylinder exceeds the boiler pressure, plus the strength of the valve springs.

GAS-COCK.—ANDREW J. WIEGAND, Baltimore, Md. A new construction of self-lighting gas burners has been patented by this inventor. A special holder is provided for the lighting substance, such as platinum sponge lighting by contact with the gas, and a spherical valve having main and auxiliary ports, is rocked on its seat by means of a handle extending through the valve casing. The rocking of the valve in one direction directs the gas through the auxiliary port to the igniter and upon releasing the handle a spring pressing thereon returns the valve to close the auxiliary port and open the main passage leading to the burner tip. The devices may be employed in connection with ordinary tips or with incandescent mantles.

ACETYLENE-GAS-GENERATING APPARATUS.—CHARLES W. METCALF, El Paso, Texas. The general construction of the apparatus enters into this patent. A prominent and novel feature is the feed devices for regulating the charge of water to the carbide chamber, which is located beneath the gasometer tank and receives water from said tank. The pipe leading to the carbide chamber has two valves, one opening by the falling of the gasometer bell to supply the water and the other to be closed by the continued falling of the bell. Thus, if the carbide is exhausted and the bell continues to fall, the water will be automatically shut off.

CISTERN-VALVE FOR WATER CLOSETS.—CHARLES SMITH, New York City, N. Y. A valve and appurtenances have been devised by this inventor, designed to prevent leakage from the tank or cistern into the flushing pipe. The outlet pipe rises above the water level, is open at the top and has a partition and a side opening forming the pipe into a siphon, the partition terminating short of the top. A float valve rests on the upper end of the pipe and a suspended sliding cup surrounds the pipe and is open at its bottom for entrance of water from the tank. By pulling the usual chain the cup rises and its water floats the ball valve and starts the siphon. All valves below the water level are thus done away with.

Mechanical Devices.

PROPELLER.—SYLVANUS C. LITTLEFIELD, JR., Brunswick, Ga. This inventor has designed a propeller having blades of a special form with respect to the edge lines and the lines of curvature given the face of the blade. The object of the invention is stated to be to reduce the suction or "drag," to throw the strain close to the shaft with a view of preventing lateral vibration of the vessel, and also to overcome any tendency of the propeller to settle the vessel deeper when at high speed, and to enable the propeller to work effectively even though not wholly submerged.

FLOORING-CLAMP.—ARTHUR L. STOWELL and ARTHUR H. ROUNDS, Gay Mills, Wis. The clamp, designed by these inventors for clamping flooring-boards, siding, or the like where a tight joint is required, is manipulated by one hand, and comprises a base plate adapted to rest on the edge of the board last laid, a short arm having a spur at its end to be pressed into one side of the joist, and a handled bar journaled on the plate in a position parallel with the short arm, the said bar having a dog with a series of teeth which engage the joist at the side opposite the spur. The rotation of the handle bar exerts the desired pressure on the board.

Miscellaneous Inventions.

DISINFECTING-BLOCK.—SAMUEL EDEN, Brooklyn, New York city. The block is composed of mercury bichloride, disinfecting oils, talcum, and Portland cement. It is designed to prevent obnoxious gases from passing into a room through sinks; to produce a healthful, invigorating atmosphere; and to minimize the danger of infection.

DRILL-TOOL SHAPER.—LOUIS F. NELL, 2558 W. Thirty-second Avenue, Denver, Colo. The inventor has devised a very simple and ingenious apparatus for enabling prospectors engaged in rock drilling who are unable to make their own bits to produce them quickly without the exercise of skill or to enable those who are skilled to produce the bits in less time and with less labor.

SHAFT-TUG.—JAMES O'CONNELL, Mount Sterling, Ky. The O'Connell shaft-tug consists of a shank having a shaft-bearing on its lower end. On the shank a spring-pressed tongue is pivoted, having a cross-piece extending from one member of the bearing to and through the other. The tongue is held against upward movement, when pressure is exerted on it by the shaft, to relieve the pivot of the tongue of undue strain. The cross-piece of the tongue is curved upwardly to give sufficient room for the shaft to play in and to allow an easy disconnection of the tug from the shaft in unhitching. This is done in the ordinary manner by loosening the traces and unbuckling the belly-band and then walking the animal out of the shafts, the closed bearing sliding off the shaft. The shafts disengage readily from the bearing without the tug's hanging back or dragging, as so frequently happens in other tugs. It is not absolutely necessary, however, to unbuckle the belly-band.

AX.—SIEVE T. JOHNSON, Trinidad, Cal. This invention relates to axes having the cutting edges formed on parts removable from the ax-head, and the inventor has provided a new form for the mating portions of the head and removable blade and a special arrangement of securing keys.

SAND SHIELD FOR VEHICLE-AXLES.—EDWIN H. WILSON, Globe Village, Mass. This inventor provides an effective sand-shield arranged to be thrown upward and away from the hub when removing the wheel. The shield has a shank pivoted on the stock of the axle and a plate-spring is provided to hold the shield in the raised or lowered position. The outer end of the shield is curved to shed the sand, and it extends over a flanged ring which is driven into the end of the hub and revolves with the latter, the shield and ring serving to prevent entrance of sand to the hub-box and spindle.

EYEGLASSES.—AUGUSTUS B. CRITZER, San Antonio, Tex. The attachments devised by this inventor are adapted to any make of eyeglasses and provide for holding and steadying the eyeglasses in proper position, by means of arms which effect a bearing above the eyes, against the frontal bone, thus relieving the usual nose-pieces of any pinching action. The arms are adjustable to different positions and will retain a given adjustment, so as to always assume the same position before the eye.

NECKTIE-FASTENER.—PHILIP N. SCHUYLER, Bellevue, Ohio. This invention relates particularly to neck-bows and string-ties. The fastener, which is made of wire, includes a loop or yoke for engaging the collar-button and ingeniously arranged hooks at the side or sides of the yoke, the hooks serving to be engaged by eyes on the ends of the neckband. The band may or may not be entirely separable from the bow.

BADGE-PIN.—GEORGE H. BROOKS, Louisville, Ky. The pin and backing plate, which relate to campaign badges and the like, are given a novel construction to insure a firm and positive fastening of the pin by spring action.

RIBBON-HOLDER.—LLOYD E. HAMILTON and JOHN W. MILLER, Hudson, Ind. In this ribbon-holder, in which the ribbon-roll revolves, a spring clamp presses on the free end of the ribbon to prevent a too free unwinding, and the form is such as to permit of moving the spring-clamp bodily toward the center of the roll as the roll becomes smaller, so that the clamp effectively holds the ribbon until the roll is entirely unwound.

NOTE.—Copies of any of these patents can be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

VERRES ET EMAUX. Par L. Coffigual. Paris: J. B. Bailliére. 1900. 129 illustrations. Pp. 332. Price $1.25.

This volume presents in concise form the most important process in the manufacture and enameling of glass. The work discusses the physics and chemistry of glass, its refractive properties, its varieties and their manufacture, and other necessary and valuable information. The latter part of the book discusses enamels.

THE NAVAL WORDBOOK. (Die Seemannssprache.) Ein systematisches Woerterbuch marine-technischer Ausdruecke in englischer und deutscher Sprache. Von N. W. Thomas, M.A. Second edition, revised and enlarged. Pp. 177. 12mo. Limp cloth. Price $1.25.

We have used the first edition of Mr. Thomas' dictionary more or less constantly for the last six months and have found it a very serviceable little book. The work has been considerably improved by the correction of a few errors and the addition of an excellently compiled list of English words. Under the heading of "ordnance" slight revisions might still be profitably made. "Laffettenwand" is usually known as a "cheek"; Wiegelafette," as a "spring-return carriage." The German equivalent for "gravity-return carriage" (Rahmenlafette) should also have been inserted. On the whole, Mr. Thomas has performed a very creditable task which deserves the thanks of all who have to translate naval terms from German into English or English into German.

Business and Personal.

Marine Iron Works. Chicago. Catalogue free.

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"U. S." Metal Polish. Indianapolis. Samples free.

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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

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Notes and Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7931) C. M. asks: 1. Can you give me any advice how to vulcanize bicycle tires? A. The process of vulcanizing rubber is described in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 251, 252, 731 and 895, price 10 cents each by mail. 2. Will a fan motor, having permanent magnetic fields, need the same number of batteries to drive it, as the same motor with electro magnet fields? A. The power is less with permanent magnets by the small amount of current to magnetize the field, of course. 3. Is telephoning allowed during a thunder storm, and why are the lights turned on during the same on a trolley car? A. The telephone exchanges do not cut off subscribers during a thunder storm. They depend upon the lightning arresters for protection. For the same reason the trolley service is not interrupted. Once in a while a burn-out occurs, but very rarely in comparison with the number of telephones and cars. Lamps are only lighted when it is dark enough to require their light.

(7932) W. W. S. asks: Does a piece of iron have more or less cubical contents when magnetized? I have tried to find out by using water and hair tubes, but I can see no change whatever. A. We should not expect to demonstrate any change in contents of an iron bar by magnetizing it. The change is of an infinitesimal order at the largest. The question has at most a theoretical interest. According to theory, the molecules are turned with their lengths in the same direction while the magnetizing current flows. They occupy no more space in this condition. We should, therefore, think that the bar as a whole would occupy no more.

(7933) L. C. S. writes: 1. As I understand it the resistance is what makes the field coil get hot. In order to avoid the heating more wire is added; now, if resistance is what heats the coil, how do you account for the coolness of the fields after adding more wire, consequently more resistance? A. Your statement that resistance causes the heating of an electric circuit is less than half right. The exact statement is that the heat developed in a circuit is directly proportional (1) to its resistance in ohms, (2) to the square of the current in amperes, (3) to the time that the current flows in seconds. Now one ampere flowing through one ohm develops 0·24 calories in one second. Putting these facts in a formula we have: Heat in calories=0·24 C^2Rt. It can now be seen why the heating of a coil can be remedied by adding more wire. The increase of resistance cuts down the amperes in the same ratio as the increase. But the reduction of the amperes affects the heating power in the ratio or the squares of the amperes. Thus, if the resistance were doubled the amperes would be halved, but the heat produced would be reduced to one-fourth of what it was, since the square of ½ is¼. 2. What is the cause of the humming in the field coils and pole pieces of an induction motor when the armature does not revolve, but the current is passing through the fields? A. The alternations of an electric current produce vibrations which are heard as sound. These can be heard near an arc light run by an alternating current, or near an alternating electro magnet. 3. What changes are necessary to reverse the running of an induction motor? Crossing the positive and negative wires at the binding posts will not do it. A. Of course, merely reversing the main wires will produce no effect upon the direction of rotation of a motor. If the induction motor is two phase, the direction of rotation will be reversed by changing the two leads of either phase. If it is three phase, it will be reversed by changing any two of the leads. The different phases are a fraction of a period behind each other, and the direction of rotation depends upon the direction in which the phases lag behind around the rotating part of the motor, whether clock-wise or contra-clock-wise. To reverse the motor the direction of the lag in phase must be reversed. 4. Would it be possible to illustrate and explain the induction motor in the SCIENTIFIC AMERICAN some time in the future? A. The induction motor has been fully treated in several books recently published: Oudin's "Polyphase Apparatus," price $3 by mail; Thompson's "Polyphase Currents," price $5 by mail. These, with Thompson's "Elementary Lessons," price $1.40, will put you in possession of quite a complete library of the subject at present.

(7934) C. B. M. writes: I have a small motor which has a magnet in place of field winding. An electrical engineer told me if I put it on a large machine it would give greater power. I did so, and it does not give any power at all. It will run without a load, but will not run backward when current is reversed as it did before. A. A motor requires the proper current, that is, a current of the number of volts for which its winding was made. It will then develop under this pressure the power it was intended to yield, for the reason that it will take the proper number of amperes from the line. A current less than this will not run the motor up to its limit, one greater than this will overheat its coils. It would appear that you must have put the motor upon an alternating current, when it was intended for a direct current, since it would not reverse nor develop power.

(7935) E. H. W. writes: I read with much interest the article on M. Tommasina's automatic coherer, in your issue of June 16, 1900, page 376, and would like to ask if it is not possible that the decoherence of the carbon particles after the spark has passed may not be due to the return of the iron diaphragm in the telephone receiver to its original position, as there is a perceptible jar due to the vibrations in a receiver on both making and breaking the circuit. A. The vibrations of a telephone diaphragm can hardly have energy enough to effect the decohesion of the particles mechanically. The point could, however, be determined by placing a coherer containing metallic powder in the same position. If it will work as well as the carbon coherer, it would justify the theory of our correspondent.

TO INVENTORS.

An experience of over fifty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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AND EACH BEARING THAT DATE.

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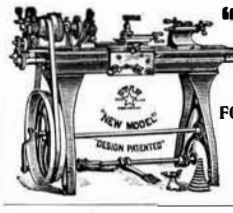

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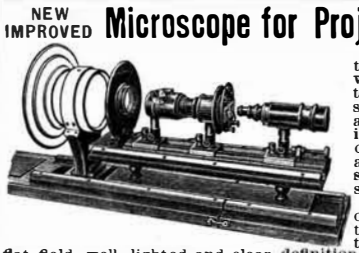

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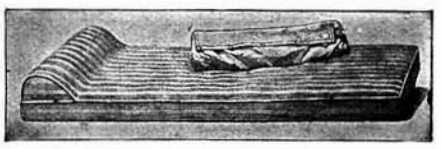

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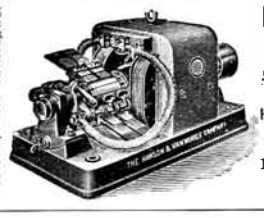

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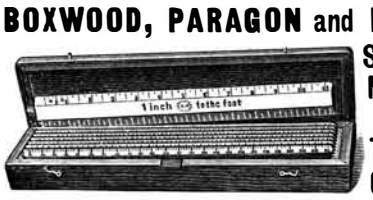

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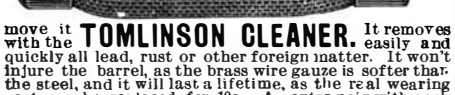

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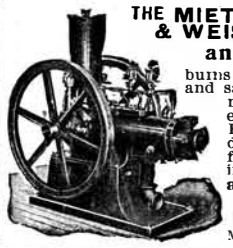

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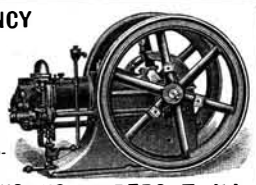

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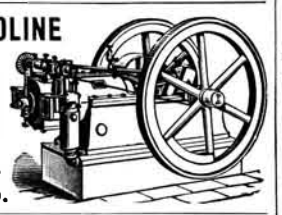

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